NAEMSP • National Association of EMS Physicians

ABEM EMS SUBSPECIALTY

Emergency Medical Services

Board Certification Exam Review

Based on Emergency Medical Services: Clinical Practice and Systems Oversight, 3rd Edition

2027 EDITION

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ABOUT THIS GUIDE

The NAEMSP EMS Board Review Guide is a high-yield review resource for the ABEM Emergency Medical Services Subspecialty Board Certification Examination. It is designed to be used alongside *Emergency Medical Services: Clinical Practice and Systems Oversight*, 3rd Edition (Cone, Brice, Delbridge & Myers, 2021), Volumes 1 and 2.

The 2027 Edition covers all 121 chapters of the core textbook, distilled into a format built for rapid review and retention. All content has been independently reviewed and rewritten from the source text by the Editor-in-Chief.

Each chapter is organized for efficient first-pass review and fast recall under time pressure. The **Priority Patch** at the end of each chapter highlights the highest-yield facts, exam traps, and mnemonics most likely to appear on the boards.

The **Last Minute Cram** section is designed for the final 24–48 hours before the exam. It is intentionally dense and focused on rapid pattern recognition, not comprehensive review.

The **Pulse Check** section contains over 350 original board-style practice questions with detailed explanations. Questions are organized by chapter and designed to reinforce high-yield content, expose common exam traps, and build confidence in test-taking strategy.

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A NOTE ON LOCAL PROTOCOLS

This guide is written for a national exam. Content specific to a single jurisdiction, agency, or region is generally not testable. If something in your local protocols differs from what you read here, that's fine — follow your protocols in the field. For the exam, the national standard governs.

MESSAGE FROM THE EDITOR

A large group of fellows, faculty, and colleagues who cared deeply about this subspecialty came together to build the first edition of this review guide. At the time, there was almost nothing available to help candidates prepare for the ABEM EMS subspecialty board examination. The subspecialty itself was brand new. Together we built something from scratch, and I'm proud of that work and grateful to NAEMSP for supporting it.

What has happened since then has been impressive to watch. The number of board-certified EMS physicians has grown steadily, fellowships have expanded across the country, and real study resources now exist where none did before. That growth reflects the hard work and dedication of physicians, fellows, providers, and partners who show up every day to take care of people in their most critical moments. Thank you. What you do matters, and the patients and communities you serve are better for it.

Dr. Ryan F. Coughlin

Editor-in-Chief, NAEMSP Board Certification Exam Review Guide

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1 History of EMS

Legislation Timeline — What the Exam Cares About

Year	Law / Event	What it did (testable)
1966	NAS-NRC "White Paper"	Identified the problem: "woefully inadequate" care; 24 recommendations; not a law
1966	Highway Safety Act	Established DOT/NHTSA; first federal EMS funding ($142M, 1968–79)
1973	EMS Systems Act	First comprehensive federal approach; 15 mandatory components; $300M; first to push universal 911
1981	Omnibus Budget Reconciliation Act	Ended direct federal EMS funding; folded EMS into state-controlled block grants
1984	EMSC Program	Pediatric EMS focus; HRSA + NHTSA jointly manage
1996	EMS Agenda for the Future	14 attributes of ideal EMS; outcomes-based research; Utstein datasets
2006	IOM: EMS at the Crossroads	EMS as community-based health management
2019	EMS Agenda 2050	People-centered vision; 6 guiding principles

Pre-1966 Landmarks (Lower Yield: Know the Names)

Jean Dominique Larrey (Napoleon's surgeon): first organized military ambulance system
Kouwenhoven + Safar: closed-chest CPR and rescue breathing (1960)
Pantridge (Belfast, 1967): first mobile coronary care unit
LACFD paramedic program (1970): legal changes enabling paramedic procedural skills

EMS Certification: Fast Facts

ABEM first offered EMS subspecialty exam: 2013
Largest EM subspecialty by volume
880 ABEM-certified EMS physicians (as of 2021); 71 ACGME-accredited fellowships
Education pipeline: core content → scope of practice → certification → education standards → accreditation

PRIORITY PATCH

▸ White Paper (1966) = identified the problem. Highway Safety Act (1966) = first federal $. Same year, different purpose: classic distractor.
▸ 1973 EMSS Act = 15 components + $300M = first comprehensive federal approach
▸ 1981 Omnibus = end of direct federal EMS funding (block grants to states)
▸ ABEM exam started 2013; largest EM subspecialty

⚡PULSE CHECK

QUESTION 1

Which legislative act first established the Department of Transportation and provided the first federal EMS funding?

A. EMS Systems Act of 1973
B. Highway Safety Act of 1966
C. Omnibus Budget Reconciliation Act of 1981
D. NAS-NRC White Paper of 1966

Answer: B

The Highway Safety Act of 1966 established DOT/NHTSA and provided the first federal EMS funding ($142M, 1968--79). The NAS-NRC White Paper of the same year identified the problem but was not legislation. The 1973 EMS Systems Act was the first comprehensive federal approach.

QUESTION 2

Which legislation ended direct federal EMS funding and folded EMS into state block grants?

A. Highway Safety Act of 1966
B. EMS Systems Act of 1973
C. Omnibus Budget Reconciliation Act of 1981
D. EMSC Program of 1984

Answer: C

The Omnibus Budget Reconciliation Act of 1981 ended direct federal EMS funding, transferring control to states via block grants. The 1973 EMSS Act was the first comprehensive federal approach with $300M.

QUESTION 3

In what year did ABEM first offer the EMS subspecialty board examination?

A. 2006
B. 2010
C. 2013
D. 2019

Answer: C

ABEM first offered the EMS subspecialty exam in 2013. EMS was recognized as a subspecialty in September 2010, catalyzed by the 2006 IOM report 'EMS at the Crossroads.'

2 EMS Airway Management — System Considerations

The Evidence Problem with Prehospital ETI

No proven survival benefit for prehospital ETI in most patient populations
Pediatric ETI: evidence suggests harm; BVM often preferred and outcomes are better
"Time off chest" during CPR is a documented harm: minimize airway interventions in cardiac arrest
After 2 failed ETI attempts → move to SGA immediately; most programs cap attempts at 2–3

6 Elements of a Successful Airway Program

Training · Skills verification · Equipment selection · Decision support · Continuing education · TQM
TQM = iterative: train → collect data → assess → re-educate; review all airway cases with directed feedback

RSI Program Requirements

Reserved for agencies with highest airway management standards
Required monitoring: ECG, BP, SpO_2, waveform capnography (mandatory for all intubated patients)
Rescue airway plan must exist before every RSI attempt
Volume threshold: ≥12 ETIs/year per paramedic (prehospital or OR combined)
RSI programs must carry longer-acting paralytics for post-intubation management

Video Laryngoscopy vs. SGA: Medical Director Decisions

Tool	Advantage	Medical director consideration
Video laryngoscopy	↑ first-pass success, ↑ view	Primary vs. rescue role; cost vs. call volume tradeoff
SGA	Higher first-pass success than ETI; easier skill maintenance	All EMS personnel should carry ≥1 type; preferred in cardiac arrest

VL improves laryngoscopic view: does not replace direct laryngoscopy skill
SGA in cardiac arrest: supports uninterrupted compressions; BLS SGA use has strong evidence

PRIORITY PATCH

- ▸ Prehospital ETI = no proven survival benefit. Peds ETI = may cause harm. BVM is often the right answer.
- ▸ 6 airway program elements: Training, Skills verification, Equipment, Decision support, Continuing education, TQM
- ▸ RSI requires: rescue airway plan + waveform capnography + ≥12 ETIs/year/provider
- ▸ Waveform capnography = mandatory for ALL intubated patients: not optional
- ▸ Wrong answer trap: "add more ETI attempts": two failures → SGA, not a third try

⚡PULSE CHECK

QUESTION 1

Which statement best reflects the current evidence on prehospital ETI in pediatric patients?

A. Pediatric ETI improves survival when performed by experienced paramedics
B. Pediatric ETI has evidence of harm; BVM is often preferred with better outcomes
C. ETI is preferred over SGA in all pediatric cardiac arrests
D. After 3 failed attempts, one additional ETI is indicated

Answer: B

Pediatric ETI has evidence of harm --- BVM is often preferred with better outcomes. Prehospital ETI has no proven survival benefit in most populations. After 2 failed attempts, protocols direct providers to move immediately to SGA.

QUESTION 2

Which monitoring modality is mandatory for ALL intubated patients in an RSI program?

A. Quantitative EtCO2 only
B. Pulse oximetry only
C. Waveform capnography
D. Arterial line blood pressure monitoring

Answer: C

Waveform capnography is mandatory for ALL intubated patients --- not optional. It is the gold standard for continuous ETT confirmation. RSI programs also require a rescue airway plan before every RSI attempt and a minimum ETIs/year per provider.

QUESTION 3

Which of the following is one of the 6 required elements of a successful EMS airway program?

A. Video laryngoscopy as the primary device for all intubations
B. Total quality management with iterative data review
C. Physician on-scene for all RSI attempts
D. BLS SGA authorization revoked for RSI-capable units

Answer: B

The 6 elements: Training, Skills verification, Equipment selection, Decision support, Continuing education, and TQM. TQM is iterative --- train, collect data, assess, re-educate --- with review of all airway cases and directed feedback.

3 Airway Procedures

Airway Progression — Always Exhaust Basics First

Position → NPA/OPA → BVM (two-person preferred) → advanced airway
BVM two-person technique: better tidal volumes, better mask seal: use it
NIPPV: decreases intubation rate, shortens LOS, improves survival: underused prehospital

RSI Drug Reference

Drug	Dose	Board-Testable Notes
Etomidate	0.3 mg/kg IV	Most common induction agent; minimal hemodynamics; adrenal suppression (clinical significance debated)
Ketamine	1–2 mg/kg IV; 2–4 mg/kg IM	Dissociative + hemodynamically stable; ↑secretions; ICP concern largely unsupported: board still tests it
Midazolam	0.1 mg/kg IV	Avoid if hemodynamically unstable: hypotension risk
Succinylcholine	1–2 mg/kg IV	Depolarizing; onset fastest; 5–9 min duration. AVOID: hyperkalemia states (renal failure, rhabdo, burn >48h, muscular dystrophy, denervation)
Rocuronium	1 mg/kg IV	Non-depolarizing; onset 1–3 min; 30–45 min duration; reversed by sugammadex 2–4 mg/kg
Vecuronium	0.1 mg/kg IV	Onset 2–4 min; 25–40 min duration; use for post-intubation paralysis maintenance

Surgical Airway

Cricothyroidotomy: membrane inferior to thyroid cartilage; open or Seldinger; 6.0 ETT or trach tube
Prehospital success rate variable (17–93%); survival 15–37%: high skill decay, rarely performed
TTJV: requires wall O_2 only (≥50 L/min): a standard BVM cannot generate enough pressure; 16G catheter + 20 BPM → ~950 mL tidal volume

Tube Confirmation: No Shortcuts

Waveform capnography = gold standard for continuous ETT confirmation
Five-point auscultation + $EtCO_2$ after every intubation
Reassess position after every patient move
Commercial tube holders: ACLS recommends; not validated prehospital; not designed for SGAs: secure separately

PRIORITY PATCH

- ▸ **L**ook externally · **E**valuate 3-3-2 · **M**allampati · **O**bstruction · **N**eck mobility
- ▸ Succinylcholine SAFE in burns <48h: hyperkalemia risk starts at 2–3 days post-burn
- ▸ Succinylcholine AVOID: renal failure, rhabdo, burn >48h, muscular dystrophy, denervation
- ▸ Rocuronium 1 mg/kg ≈ succinylcholine onset; reversed by sugammadex 2–4 mg/kg
- ▸ TTJV = wall O_2 only: BVM cannot generate sufficient pressure

⚡PULSE CHECK

QUESTION 1

A paramedic prepares to intubate a patient with known muscular dystrophy. Which paralytic agent is contraindicated?

A. Ketamine
B. Etomidate
C. Succinylcholine
D. Rocuronium

Answer: C

Succinylcholine is contraindicated in muscular dystrophy due to life-threatening hyperkalemia risk. Other contraindications include renal failure, rhabdomyolysis, burns >48 hours old, and denervation. It IS safe in burns less than 48 hours (hyperkalemia risk begins at 2--3 days post-burn).

QUESTION 2

Which statement about transtracheal jet ventilation (TTJV) is correct?

A. A standard BVM can generate sufficient pressure for TTJV
B. Wall O2 at ≥50 L/min is required
C. A 14G catheter at 30 BPM provides adequate ventilation
D. TTJV is the preferred rescue airway in most EMS systems

Answer: B

TTJV requires wall O2 at ≥50 L/min --- a standard BVM cannot generate sufficient pressure. A 16G catheter at 20 BPM provides approximately 950 mL tidal volume.

QUESTION 3

The LEMON mnemonic is used to predict which clinical problem?

A. Failed RSI induction
B. Difficult airway
C. Succinylcholine hyperkalemia risk
D. Post-intubation hypotension

Answer: B

LEMON (Look externally, Evaluate 3-3-2, Mallampati, Obstruction, Neck mobility) predicts difficult airway management. Each positive element increases likelihood of difficult laryngoscopy or intubation.

4 Airway Management — Special Situations

TCCC/TECC — Phase Determines What You Can Do

Phase	Threat	Airway options
Care under fire (direct threat)	Active	Position only: no procedures
Tactical field care (indirect threat)	Reduced	NPA/OPA, recovery position, SGA if unconscious, cricothyroidotomy
Evacuation	Low	Full options: ETI, SGA, surgical airway

Airway technique affects provider exposure: King LT has lower profile than digital intubation above cover
Complex facial trauma or operational constraints → consider early surgical airway

Ground-Level ETI: Position Matters

Left lateral decubitus: best evidence for first-pass success; right arm free for tube
Other options: prone (elbows down, wrist movement only), kneeling, sitting, straddling ("Tomahawk")

Low-Light and Other Environments

Maximize ambient light first; then: VL (preferred) → blind digital → lighted stylet → SGA
Night vision goggles: usable but significantly increase intubation time
Post-tonsillectomy hemorrhage: direct pressure ± epinephrine-soaked gauze (hold with hemostat: do not drop); anticipate difficult airway
Pandemic/infectious: PPE before touching the airway: ETI = highest-risk aerosol-generating procedure

PRIORITY PATCH

- "Care under fire" = position only. Any procedure = wrong answer.
- Left lateral decubitus = best evidence for ground-level ETI
- Tactical field care = NPA/OPA/SGA/cric allowed; ETI not implied
- ETI = highest-risk aerosol-generating procedure (PPE first, always)

⚡PULSE CHECK

QUESTION 1

During a tactical operation with active gunfire ('care under fire'), which airway intervention is appropriate?

A. Endotracheal intubation
B. Nasopharyngeal airway placement
C. Positioning only
D. Supraglottic airway insertion

Answer: C

During care under fire (active/direct threat), positioning only is performed --- no procedures. Any procedure is the wrong answer in this phase. NPA, SGA, and ETI are reserved for the tactical field care phase (indirect threat).

QUESTION 2

Which patient position has the best evidence for first-pass success during ground-level ETI?

A. Supine with cervical collar in place
B. Left lateral decubitus with right arm free
C. Sitting upright in Tomahawk position
D. Prone with elbows down

Answer: B

Left lateral decubitus position has the best evidence for first-pass ETI success at ground level, with the right arm free for tube manipulation. Other positions (prone, kneeling, sitting) are used situationally.

QUESTION 3

ETI represents the highest risk for aerosol generation in pandemic settings. What should occur before touching the airway?

A. Administer bronchodilators to reduce secretions
B. Apply waveform capnography
C. Don appropriate PPE
D. Obtain IV access for RSI medications

Answer: C

ETI is the highest-risk aerosol-generating procedure. PPE must be donned BEFORE touching the airway in any infectious context --- this is a non-negotiable step. BVM ventilation is also aerosol-generating but lower risk.

5 Respiratory Distress

$EtCO_2$ as a Diagnostic Tool: High Yield

Shark fin waveform = obstructive physiology (asthma/COPD)
Lower $EtCO_2$ → favors ADHF over COPD
Very low $EtCO_2$ + hyperglycemia → think DKA
Rising $EtCO_2$ in asthma = tiring out, not improving: $EtCO_2$ >40 = severe
Rapidly falling $EtCO_2$ in PE → impending arrest

SpO_2 Targets

General respiratory distress: 94–98%
Known COPD: 88–92% (titrate carefully; do not withhold O_2 from severely hypoxic patient)

NIPPV: Use It Early and Broadly

Evidence supports use for all forms of undifferentiated acute respiratory failure: not just COPD/CHF
↓ mortality, ↓ intubation rates, ↓ ICU LOS
Contraindications: immediate ETI needed, unable to protect airway, vomiting, altered mentation, inadequate respiratory drive

Asthma: Severity and Treatment

Severity	Speech	HR	$EtCO_2$	Key action
Mild	Full sentences	<100	20–30	SABA
Moderate	Phrases	100–120	30–40	SABA + ipratropium
Severe	Words	>120	**>40**	Epi IM + Mg + NIPPV; prepare for RSI

RSI induction agent: ketamine (bronchodilator properties)
Post-intubation ventilation: low TV, low RR, prolonged expiratory phase; permissive hypercapnia; watch for barotrauma
Magnesium sulfate: 1–2 g IV over 15–30 min for severe/refractory
Corticosteroids: not proven in RCTs but used universally: observational data supports

COPD Exacerbation

SABA + ipratropium → NIPPV → ETI if failing
Corticosteroids: ↓ treatment failure; antibiotics: appropriate for selected exacerbations
ETI ventilation: same as asthma: low RR, prolonged expiration, watch barotrauma

ADHF vs. SCAPE: Don't Confuse Them

	ADHF	SCAPE
Onset	Days to weeks	Minutes to hours
Volume status	Often overloaded (edema, JVD)	May NOT look volume overloaded
BP	Variable	Usually hypertensive
Treatment	NIPPV + nitrates	High-dose NTG bolus + NIPPV

NTG: SL 400 mcg q5 min; high-dose IV bolus (0.5–2 mg) for SCAPE with SBP >160
Transdermal patch: NOT recommended prehospital (slow absorption, unreliable perfusion)
NTG contraindications: PDE-5 inhibitors, suspected RV MI (inferior ST + lead III > lead II elevation)
US B-lines = interstitial fluid → supports ADHF/SCAPE diagnosis
Drugs to avoid in ADHF/SCAPE: Morphine (ADHERE data: associated with ↑ mortality and adverse outcomes) and furosemide (rarely indicated prehospital: delayed onset, unreliable volume assessment in the field). If you see morphine as a choice for ADHF on the boards, it's wrong.

PE: Recognize It, Know What Doesn't Work

Most common symptom: dyspnea; most common signs: tachycardia + tachypnea
Massive/saddle PE: obstructive shock: JVD, hypoxemia, syncope, narrow-complex PEA
ECG: S1Q3T3, right axis deviation, RBBB, T-wave inversions in V1 and lead III
Prehospital tPA for PE-related cardiac arrest: NOT supported by RCT evidence

Narrow complex PEA + witnessed arrest → think massive PE

Tension Pneumothorax: Act Before Late Signs

JVD and tracheal deviation are late: do not wait for them
Mechanism: one-way air trapping → ↑ intrathoracic pressure → ↓ venous return → obstructive shock
Needle decompression: preferred site (ACS CoT) = 4th–5th ICS, anterior axillary line (not 2nd ICS MCL: higher failure rate + vessel risk)
Never below nipple line; 14G or larger; repeat if reaccumulates
Finger thoracostomy: 3–4 cm incision at MAL just above nipple; more reliable for experienced providers

Tracheotomy Emergencies

Most common cause of distress: mucus plugging: suction → remove inner cannula → suction tube
Tube placed <7 days: do NOT remove (collapse/false passage risk)
Mature tract (>7 days): can replace through stoma with ETT ± bougie

PRIORITY PATCH

- ▸ Shark fin waveform = obstructive (asthma/COPD). Lower $EtCO_2$ favors ADHF over COPD.
- ▸ Rising $EtCO_2$ in asthma = tiring out. $EtCO_2$ >40 = severe. Normal $EtCO_2$ + wheezing = pre-arrest.
- ▸ NIPPV works for all undifferentiated respiratory failure, not just COPD/CHF
- ▸ SCAPE: high-dose NTG bolus + NIPPV. Morphine and furosemide = wrong answers.
- ▸ Tension PTX: decompress at 4th-5th ICS AAL, not 2nd ICS MCL. Don't wait for tracheal deviation.

Nitrates + **Ni**PPV

⚡PULSE CHECK

QUESTION 1

A severe asthmatic has an EtCO2 of 44 mmHg. What does this indicate?

A. Patient is improving; CO2 is appropriately normalizing
B. Normal finding; no escalation needed
C. Patient is tiring; this is a sign of severe exacerbation
D. Suggests DKA rather than asthma

Answer: C

EtCO2 >40 in asthma indicates a tiring patient --- a severe exacerbation sign. In early asthma, tachypnea drives EtCO2 down (20--30 mmHg). A rising EtCO2 in asthma means fatigue and impending respiratory failure --- escalate to epinephrine, magnesium, NIPPV, and prepare for RSI.

QUESTION 2

Which feature best distinguishes SCAPE from typical ADHF?

A. SCAPE presents over days and typically requires diuresis
B. SCAPE presents acutely over minutes to hours, is usually hypertensive, and requires high-dose NTG
C. SCAPE presents with hypotension requiring vasopressors
D. SCAPE is best treated with CPAP alone without nitrates

Answer: B

SCAPE (sympathetic crashing APE) presents over minutes to hours, usually with hypertension (SBP >160), and may not appear volume overloaded. Treatment: high-dose NTG bolus (0.5--2 mg IV) plus NIPPV. Transdermal NTG is NOT recommended prehospitally.

QUESTION 3

Which SpO2 target is recommended for patients with known COPD?

A. 94--98%
B. 98--100%
C. 88--92%
D. <85% to preserve hypoxic drive

Answer: C

Target SpO2 88--92% in known COPD to avoid oxygen-induced hypercapnia. Never withhold oxygen from a severely hypoxic COPD patient. For most other patients, target 94--98%.

6 Oxygenation and Ventilation

Oxygenation vs. Ventilation: The Core Distinction

	Oxygenation	Ventilation
Measures	O_2 delivery to tissues	CO_2 elimination / air movement
Monitor	Pulse oximetry (SpO_2)	Waveform capnography ($EtCO_2$)
Normal	SpO_2 96–99%	$EtCO_2$ 35–45 mmHg
Key limitation	Lags; false normal in CO poisoning	$EtCO_2$ runs 3–5 mmHg below $PaCO_2$
Speed of change	Slow (Hgb buffer)	Fast: changes nearly immediately

Pulse Oximetry: Know the Traps

Unreliable with poor perfusion (shock, cold), nail polish, motion artifact
Does NOT distinguish oxyhemoglobin from carboxyhemoglobin: CO poisoning reads falsely normal
Above 90% SpO_2, large changes in PaO_2 produce little change in SpO_2 (flat part of the curve)

Capnography: What the Waveform Tells You

$EtCO_2$ low	$EtCO_2$ high
Hyperventilation	Hypoventilation
Shock / cardiac arrest	ROSC after arrest
Hypothermia	Fever / thyroid storm
Massive PE	Bicarb administration / tourniquet release

Shark fin waveform: obstructive physiology (asthma/COPD); slow expiratory upstroke
$EtCO_2/PaCO_2$ gap widens to 10–20 mmHg with poor pulmonary perfusion or high dead space
$EtCO_2$ >40 in asthma: severe exacerbation, patient tiring

Supplemental O_2: Devices and Targets

Device	Flow (L/min)	FiO_2
Nasal cannula	1–6	24–44%
Simple face mask	5–12	35–55%
Non-rebreather mask	8–15	**60–95%**
Venturi mask	4–15	24–50% (precise)

Target SpO_2 94–98% most patients; 88–92% in COPD
Avoid unnecessary hyperoxia: potential harm in stroke, MI, post-arrest
Never withhold O_2 from a severely hypoxic patient over hypoxic drive concerns

NIPPV (CPAP / BiPAP)

CPAP: constant pressure; start 5–10 cmH_2O (max 20 cmH_2O)
BiPAP: higher inspiratory pressure, lower expiratory; better tolerated with high work of breathing
Indications: ADHF, COPD, asthma, pneumonia, undifferentiated respiratory failure
Contraindications: unable to protect airway, vomiting, AMS, no respiratory drive

BVM Ventilation

Two-person technique preferred: better seal and tidal volume
Standard adult bag = 1,500 mL; full squeeze delivers excess TV; use 1,000 mL bag if possible
Hyperventilation is harmful: avoid except for specific indications (herniation)

Mechanical Ventilation: Initial Settings

Setting	Starting point	Notes
Tidal volume	6–8 mL/kg IBW (ARDS); 8–10 mL/kg (trauma/COPD)	Always use ideal body weight
PEEP	5–10 cmH_2O	Higher for ARDS/pulmonary edema
Rate	Per clinical need	Increase rate if using low TV

AC mode: every breath (patient or machine triggered) gets full set volume
SIMV: machine breaths = set volume; patient-triggered breaths = effort-dependent
AC = SIMV when patient has no spontaneous effort
Metabolic acidosis (DKA, sepsis): maintain pre-intubation respiratory rate; do not let $EtCO_2$ normalize suddenly

Vent Troubleshooting: High PIP

High PIP = ↑ airway resistance (secretions, bronchospasm, kinked tube) OR ↓ compliance (edema, PTX, effusion, air trapping)
Low PIP = circuit leak
Sudden high PIP + ↓ SpO_2 + ↓ BP in vented patient: tension PTX until proven otherwise
COPD/asthma on vent: prolong expiratory time (I:E 1:3 or 1:4); watch for auto-PEEP

PTX and Air Transport

Helicopter at 1,000–3,000 ft: usually not enough altitude for significant PTX expansion
~6,000 ft (instrument conditions): PTX expands ~25% (Boyle's Law)
Fixed-wing (especially unpressurized): do not transport known PTX without tube thoracostomy

PRIORITY PATCH

- ▸ $EtCO_2$ changes faster than SpO_2. Capnography is the better real-time respiratory monitor.
- ▸ CO poisoning: SpO_2 reads falsely normal. Always consider in enclosed-space exposure.
- ▸ Shark fin = obstructive (asthma/COPD). Waveform normalization = patient improving.
- ▸ Sudden high PIP + hypotension + desaturation in vented patient: decompress for tension PTX.
- ▸ PTX at 6,000 ft altitude expands ~25%. Fixed-wing transport requires tube thoracostomy first.
- ▸ $EtCO_2$ normal: 35–45 mmHg; runs 3–5 below $PaCO_2$
- ▸ ARDS TV: 6–8 mL/kg IBW; trauma/COPD: 8–10 mL/kg IBW
- ▸ CPAP start: 5–10 cmH_2O; max 20 cmH_2O
- ▸ NRB: 60–95% FiO_2. Nasal cannula at 6 L/min: ~44%

⚡PULSE CHECK

QUESTION 1

A CO poisoning victim is unresponsive with SpO2 of 98%. Which statement is correct?

A. The high SpO2 excludes significant CO exposure
B. Pulse oximetry cannot distinguish carboxyhemoglobin from oxyhemoglobin
C. SpO2 is the preferred monitoring tool in CO poisoning
D. SpO2 of 98% confirms adequate tissue oxygenation

Answer: B

Standard pulse oximetry cannot distinguish carboxyhemoglobin from oxyhemoglobin --- it reads falsely normal in CO poisoning. This is a classic exam trap. Waveform capnography monitors ventilation (CO2 elimination), not oxygenation.

QUESTION 2

A 'shark fin' waveform on capnography indicates which physiology?

A. Esophageal intubation
B. Obstructive airway physiology (asthma/COPD)
C. Return of spontaneous circulation
D. Massive pulmonary embolism

Answer: B

The shark fin waveform (slow expiratory upstroke) indicates obstructive airway physiology. ROSC produces a rising EtCO2. Massive PE produces a rapidly falling EtCO2. Esophageal intubation produces a flat or rapidly declining waveform.

QUESTION 3

Which oxygen delivery device provides the most precise FiO2?

A. Non-rebreather mask
B. Simple face mask
C. Venturi mask
D. Nasal cannula

Answer: C

The Venturi mask provides the most precise FiO2 (24--50%), making it ideal for COPD patients requiring controlled oxygen. Non-rebreather delivers up to 60--95% FiO2 but imprecisely. Nasal cannula delivers 24--44% depending on flow rate and breathing pattern.

7 Hypotension and Shock

Physiology Fundamentals

BP = Cardiac Output × Peripheral Vascular Resistance
CO = Heart Rate × Stroke Volume
Shock = inadequate tissue perfusion → tachycardia, tachypnea, AMS, cool/clammy skin, ↓$EtCO_2$
VS errors by EMTs occur >20% of the time → repeat assessments, never anchor on one set
Any episode of prehospital hypotension = evidence of serious illness until proven otherwise
Prehospital hypotension → ~30% higher mortality

Shock Classification ("Pump-Fluid-Pipes")

Type	Mechanism	Examples	Exam Clue
Hypovolemic	↓ intravascular volume	Hemorrhage, GI losses, burns	Flat JVD, tachycardia, pallor
Distributive	↑ pipe size (vasodilation)	Sepsis, anaphylaxis, neurogenic	Flat JVD; neurogenic = bradycardia + pink skin
Obstructive	Pipe obstruction	Tension PTX, PE, tamponade	JVD, tachycardia, cyanosis
Cardiogenic	Pump failure	MI, arrhythmia, cardiomyopathy	JVD, tachycardia, cyanosis

Hemodynamic Clues

Shock Index = Pulse Rate ÷ SBP: Normal: 0.5–0.8 | Shock: >1
Narrow pulse pressure (<30 mmHg or <25% of SBP) → early hypovolemic or obstructive shock
Wide pulse pressure → distributive shock
$EtCO_2$ inversely correlates with serum lactate → useful surrogate for lactate in the field

Treatment Principles

Isotonic crystalloid IVF (IV or IO), hemostatic agents/tourniquets, vasopressors as indicated
Permissive hypotension in traumatic hemorrhage:
Goal: restore peripheral pulse, or SBP 80–90 mmHg (exact target not defined)
Studies show no survival benefit from aggressive prehospital IVF in short-transport-time systems
Pediatric shock: ↓CO + ↑SVR; may need ≥60 cc/kg for resuscitation
Pneumatic anti-shock garments (PASG): no proven benefit; worsened outcomes in thoracic injury

Sepsis in EMS

Sepsis prevalence in EMS: ~3.3 per 100 patients (higher than STEMI or stroke)
30–40% of severe sepsis hospitalizations arrive via EMS
Prehospital identification is challenging: hypotension/fever often absent in field
$EtCO_2$ <25 may suggest elevated lactate → use as screening tool
Field sepsis tools have mixed sensitivity; clinician impression alone is poor
Goal: early recognition, IV access, transport: antibiotics initiated in-hospital

Protocol Framework for Shock

Perform initial assessment and identify shock type
Prioritize definitive/lifesaving interventions (airway, hemorrhage control, decompression)
"Load and go": avoid unnecessary prehospital delay
Minimize on-scene time; procedures performed en route when possible

PRIORITY PATCH

- ▸ Neurogenic shock = bradycardia + warm/pink skin. Only distributive shock without tachycardia. Classic trap.
- ▸ Shock Index (HR/SBP) >1 = significant shock even with "normal" BP.
- ▸ Narrow pulse pressure (<25-30 mmHg) = early hypovolemic or obstructive shock.
- ▸ Permissive hypotension in hemorrhagic trauma: SBP 80-90 (no TBI), MAP 50-65.
- ▸ Prehospital hypotension = ~30% higher mortality. Take every episode seriously.

⚡PULSE CHECK

QUESTION 1

Which type of shock fits the presentation of a suspected spinal cord injury with bradycardia, hypotension, and warm skin?

A. Hypovolemic shock
B. Cardiogenic shock
C. Distributive (neurogenic) shock
D. Obstructive shock

Answer: C

Neurogenic shock from spinal cord injury: bradycardia + warm/pink skin (loss of sympathetic tone) + hypotension. Other distributive and hypovolemic shock causes tachycardia. Flat JVD, bradycardia, and warm skin are the neurogenic triad.

QUESTION 2

The Shock Index is calculated as HR ÷ SBP. A value greater than 1.0 indicates:

A. Adequate perfusion with compensated shock
B. Significant hemorrhagic shock; better predictor than either value alone
C. Cardiogenic shock requiring immediate cardioversion
D. Normal finding in athletic individuals

Answer: B

Shock Index = HR ÷ SBP. Normal: 0.5--0.8. Greater than 1.0 = significant hemorrhagic shock and is a better predictor than HR or SBP alone. Narrow pulse pressure (<30 mmHg) is also an early indicator of hypovolemic or obstructive shock.

QUESTION 3

What is an appropriate target when treating permissive hypotension in traumatic hemorrhagic shock?

A. SBP >120 mmHg to ensure organ perfusion
B. Restore peripheral pulse or SBP 80--90 mmHg
C. Avoid all IV fluids until surgical hemorrhage control
D. Vasopressors to maintain MAP >65 mmHg

Answer: B

Permissive hypotension targets restoration of peripheral pulse or SBP 80--90 mmHg. Studies show no survival benefit from aggressive prehospital IVF in short-transport systems. Goal: limit further hemorrhage by avoiding excessive pressure.

8 Vascular Access

Physics of Flow

Poiseuille's Law: Flow ∝ r^4 and inversely ∝ length
Largest gauge, shortest catheter = maximum flow
"Two large-bore IVs" for trauma: evidence shows minimal survival benefit; concern for scene time delay

Peripheral IV Access: Key Points

Most common sites: antecubital fossa, forearm, dorsum of hand, external jugular, scalp (peds)
Approach vessel at <30° angle, bevel up; advance needle after flash, then slide catheter over needle
External jugular is a reliable alternative when peripheral access fails

Intraosseous (IO) Access

Site	Landmark
Proximal tibia	2 finger-breadths below and medial to tibial tuberosity
Humeral head	Arm adducted, palm pronated; palpate greater tuberosity
Distal tibia	Abduct/externally rotate hip; flat portion just proximal to medial malleolus

IO can infuse all resuscitation drugs and fluids
Dialysis fistula: last resort; acceptable in extremis
Lidocaine 2% IO (preservative-free): prior to flush can reduce pain in awake patients

Pediatric Vascular Access

Pain/anxiety management: topical EMLA cream, small-dose intranasal/IM analgesics
IO is preferred over prolonged peripheral attempts in critically ill children
Central venous access rarely needed in field; IO provides equivalent emergent access

Ultrasound-Guided IV Access

Static (locate vein) or dynamic (visualize needle in real-time) approach
Reduces central line use; noninferior to external jugular in difficult access
Prehospital use increasing with availability of handheld devices

PRIORITY PATCH

- ▸ IV in transit, not on scene in trauma. >50% of prehospital IVs are never used before ED arrival.
- ▸ IO can deliver all drugs and fluids. Preferred over repeated failed peripheral attempts in critical patients.
- ▸ Lidocaine 2% IO (preservative-free) before flush reduces pain in awake patients.
- ▸ Largest gauge + shortest catheter = maximum flow (Poiseuille's law).
- ▸ Dialysis fistula: last resort only, acceptable in extremis.

⚡PULSE CHECK

QUESTION 1

According to Poiseuille's Law, which IV catheter configuration maximizes flow?

A. Long, large-bore catheter
B. Short, large-bore catheter
C. Short, small-bore catheter
D. Long, small-bore catheter

Answer: B

Poiseuille's Law: flow is proportional to radius to the 4th power and inversely proportional to length. Shortest, largest-bore catheter = maximum flow. This is the physics basis for 'two large-bore IVs' in trauma.

QUESTION 2

Which medication can be administered IO before flushing to reduce pain in awake patients?

A. Morphine 2 mg IO
B. Lidocaine 2% (preservative-free) IO
C. Midazolam 2 mg IO
D. Sodium bicarbonate 1 mEq/kg IO

Answer: B

Lidocaine 2% (preservative-free) IO prior to flush significantly reduces pain in awake patients requiring IO access. IO can deliver all resuscitation drugs and fluids and is preferred over repeated failed peripheral attempts in critically ill patients.

QUESTION 3

The humeral head IO site requires which patient positioning?

A. Arm abducted with palm supinated
B. Arm adducted with palm pronated
C. Arm extended at 90° with elbow flexed
D. Arm in external rotation with forearm elevated

Answer: B

Humeral head IO: arm adducted, palm pronated to access the greater tuberosity. Proximal tibia: 2 finger-breadths below and medial to tibial tuberosity. Distal tibia: hip abducted and externally rotated, just proximal to the medial malleolus.

9 Chest Pain and Acute Coronary Syndromes

Epidemiology

MI occurs every ~26 seconds in the US
Mortality from MI: ~10× that of MVAs
Chest pain patients arriving via EMS have **higher pretest probability of MI** than walk-in ED patients
EMD accuracy: PPV for ACS ~6% vs. PPV for stroke ~42%
EMD should instruct patients with non-traumatic chest pain to take ASA → reduces mortality

12-Lead ECG in EMS

Three interpretation methods: (1) computer algorithm, (2) paramedic read, (3) physician transmission
Computer algorithm: **high specificity, but misses up to 20% of true STEMIs**
Paramedic interpretation requires training; accuracy depends on experience
Physician transmission: highest accuracy; ideal when infrastructure available
Simultaneous transmission to ED + interventional cardiologist further reduces time to PCI

STEMI Mimics (ST Elevation ≠ STEMI)

LBBB
Acute pericarditis/myocarditis
Hyperkalemia
Brugada syndrome / ARVC
Pulmonary embolism
Normal variant / early repolarization
Prinzmetal angina
Post-cardioversion

Medications for ACS

ASA is the only prehospital ACS drug with proven mortality benefit. Give as early as possible, including pre-arrival if EMD-directed. ISIS-2: 26 fewer deaths per 1,000 patients treated.
Adjuncts (O_2, NTG, opiates, beta-blockers) have limited, unclear, or potentially harmful evidence in the prehospital ACS setting. Use clinical judgment; do not delay transport for them.

Prehospital Fibrinolysis

Feasible, safe, effective where PCI not readily available (long transport times)
PCI reduces mortality more than fibrinolysis when available
Shortening door-to-balloon time by 30 minutes reduces in-hospital STEMI mortality by ~1%

Systems of Care for STEMI

Designated receiving centers (PCI-capable)
Prehospital 12-lead with advance hospital notification → earlier cath lab activation
Air medical transport to PCI-capable center when ground transport exceeds 30 min
Expanding BLS role in 12-lead acquisition and early ASA administration

PRIORITY PATCH

- ASA = only prehospital ACS drug with proven mortality benefit. Give pre-arrival when EMD-directed.
- Computer algorithm misses up to 20% of STEMIs. Don't anchor on a negative computer read.
- Routine O_2 in ACS without hypoxia may worsen outcomes. Use only if SpO_2 <94%.
- RV infarct: inferior STEMI + hypotension + JVD. NTG = contraindicated.
- MONA is outdated. Morphine downgraded (IIa) in NSTEMI. Fentanyl preferred prehospitally.

⚡PULSE CHECK

QUESTION 1

Which prehospital ACS medication has the only proven mortality benefit?

A. Sublingual nitroglycerin
B. Aspirin
C. Morphine
D. Supplemental oxygen for all patients

Answer: B

Aspirin is the only prehospital ACS drug with proven mortality benefit. ISIS-2 showed 26 fewer deaths per 1,000 patients treated. Give as early as possible, including pre-arrival if EMD-directed. Adjuncts (O2, NTG, opiates, beta-blockers) have limited or potentially harmful evidence prehospitally.

QUESTION 2

Computer algorithm interpretation of prehospital 12-lead ECGs for STEMI identification has which limitation?

A. Very low specificity causing excessive false positives
B. High specificity but misses up to 20% of true STEMIs
C. Unable to identify LBBB as a STEMI mimic
D. Requires physician confirmation before any result is valid

Answer: B

Computer algorithms have high specificity but miss up to 20% of true STEMIs. Physician transmission has the highest accuracy. Paramedic interpretation depends on training and experience. Simultaneous transmission to ED and interventional cardiologist further reduces time to PCI.

QUESTION 3

Which of the following is a recognized STEMI mimic (ST elevation without coronary occlusion)?

A. Right bundle branch block
B. First-degree AV block
C. Left bundle branch block (LBBB)
D. Sinus tachycardia with LVH

Answer: C

LBBB is a classic STEMI mimic. Other mimics: acute pericarditis/myocarditis, hyperkalemia, Brugada syndrome, PE, normal variant early repolarization, Prinzmetal angina, and post-cardioversion changes.

10 Cardiac Dysrhythmias

Field Assessment Framework

Is the patient unstable? (Hypotension + chest pain + altered LOC) → treat first, classify second
Classify the rhythm: rate (fast/slow/normal) + regularity + QRS width (narrow <0.12 sec vs. wide)
Stable but symptomatic? → IV, monitoring, transport; consider medications en route

Unstable Tachyarrhythmias

All unstable patients with wide or narrow complex tachy → **synchronized cardioversion**
Initial energy: **100 J** biphasic for regular rhythms; increase stepwise to 200 J
Irregular or no QRS sensing → **unsynchronized shock immediately**
Pulseless + irregular tachy → high-energy unsynchronized shock (treat as VF)
Do not delay cardioversion for sedation in truly unstable patients (sedate if time allows)

Wide Complex Tachycardia (WCT): VT vs SVT

Feature	Suggests VT	Suggests SVT-with-aberrancy
History of prior MI or VT	✅	❌
Response to vagal maneuvers	No change	May slow/terminate
Response to adenosine	Usually no effect	Slows or terminates
Response to lidocaine	Terminates 75–85%	Little effect
Rate >220/min + chaotic	WPW + A-fib	—

Antiarrhythmics

Amiodarone: 5 mg/kg IV over 5 min (VT/VF)
Lidocaine: 1.0–1.5 mg/kg IV (up to 3 mg/kg); terminates 75–85% of VT
⚠ **Lidocaine in hyperkalemia: risk of asystole** — avoid specifically in this context
Adenosine: narrow complex SVT; also diagnostic for WCT
Diltiazem / Verapamil: narrow complex SVT only; never in WCT of unknown origin
Glucagon (1–3 mg IV): beta-blocker or calcium channel blocker overdose bradycardia

Bradyarrhythmias

Stable bradycardia → monitor and transport
Unstable bradycardia → **transcutaneous pacing first** (preferred); atropine 0.5–1 mg IV (up to 3 mg)
Do not delay pacing to give atropine in the hemodynamically unstable patient
If pacing normalizes HR but hypotension persists → IV fluids + vasopressor infusion

Special Dysrhythmias

Torsades de Pointes (TdP)
"Pause-dependent": most likely when HR drops below 80–100/min
Most antiarrhythmics (except lidocaine and CCBs) can worsen QT and TdP
Unstable: **cardiovert**; recurrent: transcutaneous pacing or isoproterenol to keep HR >120
Magnesium sulfate 2g IV push for those failing cardioversion
Pediatric Dysrhythmias
Children <5 years: sinus tachycardia up to **225/min** can be physiologic stress response
Treat the cause first (hypovolemia, hypoxia, hypercarbia) before antiarrhythmics
Unstable: **2 J/kg** synchronized cardioversion
Bradycardia: usually respiratory etiology → epinephrine + airway; atropine 0.02 mg/kg rarely needed
Hyperkalemia and Rhythm
Most common cause of renal failure rhythm disturbances
Early calcium (gluconate preferred over chloride: 3:1 dose ratio; chloride causes more vein damage)
Avoid lidocaine specifically in hyperkalemia (risk of asystole)

Protocol Pearls

Obtain ECG strips whenever possible (not just monitor screen)
Bradycardia and tachycardia protocols must distinguish **stable/asymptomatic** vs. **symptomatic/unstable**

Prophylactic lidocaine for PVCs: **no benefit**

PRIORITY PATCH

- ▸ Unstable = hypotension + chest pain + altered LOC. Treat first, classify second.
- ▸ All unstable tachyarrhythmias: synchronized cardioversion at 100 J biphasic.
- ▸ WCT with prior MI history = VT until proven otherwise. Don't give calcium channel blockers.
- ▸ Chaotic WCT >220/min = WPW + A-fib. Do NOT give adenosine, verapamil, or digoxin.
- ▸ TdP: Mg 2g IV push. Most antiarrhythmics worsen it. Pace to HR >100 for recurrence.

⚡PULSE CHECK

QUESTION 1

A hemodynamically unstable patient with known WPW has an irregular rapid wide complex tachycardia. What is the correct treatment?

A. Adenosine 6 mg IV
B. Diltiazem 0.25 mg/kg IV
C. Synchronized cardioversion
D. Lidocaine 1.5 mg/kg IV

Answer: C

Unstable patients with any tachyarrhythmia require immediate synchronized cardioversion. AV-nodal blockers (adenosine, diltiazem, verapamil) are contraindicated in WPW with AF --- they can accelerate conduction through the accessory pathway, precipitating VF.

QUESTION 2

Which antiarrhythmic carries a specific risk of asystole when used in hyperkalemia?

A. Amiodarone
B. Adenosine
C. Lidocaine
D. Procainamide

Answer: C

Lidocaine in hyperkalemia carries a specific risk of asystole --- avoid in this context. Otherwise, lidocaine terminates 75--85% of VT. This is a high-yield exam trap.

QUESTION 3

An unstable bradycardic patient is unresponsive to atropine. What is the preferred next step?

A. Double the atropine dose to 2 mg IV
B. Initiate transcutaneous pacing immediately
C. Begin a dopamine infusion at 5 mcg/kg/min
D. Await emergency transvenous pacing only

Answer: B

Transcutaneous pacing is the preferred treatment for hemodynamically unstable bradycardia unresponsive to atropine. Do not delay pacing for additional pharmacologic attempts in the unstable patient.

11 Cardiac Procedures and Managing Technology

Intra-Aortic Balloon Pump (IABP)

Mechanism:
Deflates just *before* systole → ↓afterload
Inflates during *diastole* → ↑coronary and carotid perfusion pressure
Placement:
Femoral artery → thoracic aorta
Tip: 1–2 cm distal to left subclavian origin; **must be above renal arteries**
Radiographic landmark: tip between 2nd–3rd ICS
Indications: Acute MI, cardiogenic shock, ventricular aneurysm, LV failure, valve/papillary muscle rupture
Contraindications:

Absolute	Relative
Aortic dissection	Bleeding disorders
Abdominal aortic aneurysm	Severe atherosclerosis
Aortic valve incompetence	—

Timing (critical for function):
Diastole → balloon **inflated** → coronary/carotid perfusion
Systole → balloon **deflated** just prior
Trigger modes (ECG primary; arterial pressure secondary):
Cardiac arrest → "Trigger Arrest" alarm → **switch to Arterial Trigger**
If arterial pressure insufficient → **Internal Trigger** (last resort; prevents thrombus)
ROSC → discontinue Internal Trigger and return to ECG/arterial mode
IABP failure → manual pump with **Luer-Lok syringe** (4–5 times every 5–10 min)

Non-IABP Percutaneous Mechanical Circulatory Support

Impella®: axial flow pump; femoral artery → retrograde across aortic valve → LV to aortic root
Requires correct positioning across aortic valve for function
TandemHeart®: LA-to-aorta pump (requires transseptal puncture)
ECMO: RA-to-aorta; highest support level; specialized team required

Ventricular Assist Devices (VAD/LVAD)

Physiology:
Cannula in LV apex → pump → cannula in ascending aorta
Patients have no palpable pulse and no measurable BP by standard methods
Measure MAP with Doppler (normal goal: 70–90 mmHg)
Prehospital LVAD Encounters:
Do NOT cut clothing with shears: may cut LVAD driveline/wires
Obtain EKG
Check battery levels and controller function first
Hemodynamic compromise → IV fluids (RV preload-dependent)
Treat arrhythmias only if symptomatic (LVAD tolerates many arrhythmias)
CPR: Only in 2nd-generation or later LVADs, and only as last resort
Transport to **LVAD-capable facility only**: bring all batteries, controllers, equipment
Call the LVAD implanting team ASAP: invaluable resource

Implanted Cardiac Pacemakers

Five-letter NASPE/NBG code (first 3 letters most important):
NASPE/NBG Pacemaker Code — Letter Position Meanings

Position	Meaning
1st letter	Chamber **paced** (A=Atrial, V=Ventricular, D=Dual)
2nd letter	Chamber **sensed**
3rd letter	**Response** after sensing (I=Inhibited, T=Triggered, D=Dual, O=None)

Common modes:

Common Pacemaker Code Combinations

Code	Meaning
VVI	Vent paced; vent sensed; inhibited by native beat: most common single-chamber
DDD	Dual paced; dual sensed; inhibited by either: most common dual-chamber
DOO / VOO	Asynchronous fixed-rate (no sensing): magnet mode

Magnet placed over pacemaker → converts to asynchronous fixed-rate (AOO/VOO/DOO)

Useful for: pacemaker-mediated tachycardia, inappropriate inhibition

Pacemaker malfunction signs:

Pacer spikes present but patient remains bradycardic → failure to capture

No pacer spikes + bradycardia → failure to fire

Pacer spikes before every tachycardic beat → pacemaker-mediated tachycardia

Implantable Cardioverter-Defibrillators (ICD)

Three EMS scenarios:

ICD: Three EMS Scenarios

Scenario	Finding	Action
1	ICD not firing + VT/VF on monitor	Treat rhythm; external defibrillation safe (>8 cm from device)
2	ICD firing appropriately + VT/VF	Support and transport; may need additional external shocks
3	ICD firing inappropriately (no VT/VF)	**Place magnet over device to inhibit shocks**

Standard examination gloves may be insufficient protection from ICD discharge to rescuer

Pacemaker pads must be kept **≥10 cm** from the ICD/pacemaker generator

Temporary Transvenous Pacemakers (Interfacility Transport)

Wires placed via RIJ or left subclavian; connected to external generator

Settings to know: rate, sensitivity (mV threshold), energy output (mA)

Sensitivity too low → detects transport vibration as R waves → won't pace appropriately

Sensitivity too high → doesn't sense native rhythm → paces asynchronously

Do not leave patient without capture monitoring during transport

PRIORITY PATCH

▸ IABP inflates in diastole (coronary perfusion), deflates before systole (afterload reduction). Classic exam timing question.
▸ IABP absolute contraindications: aortic dissection, AAA, aortic valve incompetence.
▸ Blood in IABP balloon syringe = rupture. Do NOT reinject: arterial gas embolism.
▸ LVAD patients have no palpable pulse. Check the device before starting CPR.
▸ ICD firing inappropriately (no VT/VF on monitor): place magnet over device to inhibit shocks.
1st: chamber Paced (A/V/D)
2nd: chamber Sensed (A/V/D)
3rd: Response (I=inhibit, T=trigger, D=dual)

⚡PULSE CHECK

QUESTION 1

EMS responds to an LVAD patient with altered mental status. Which action should be avoided?

A. Applying ECG leads
B. Checking battery status and connections
C. Cutting clothing with trauma shears
D. Measuring MAP with Doppler

Answer: C

Never cut clothing with shears in LVAD patients --- the external driveline and wires can be severed, causing immediate device failure and cardiac arrest. LVAD patients have no palpable pulse; use Doppler to measure MAP (goal 70--90 mmHg).

QUESTION 2

An IABP displays 'Trigger Arrest' during CPR. What is the correct action?

A. Switch immediately to Internal Trigger
B. Switch to Arterial Pressure Trigger
C. Continue ECG trigger and proceed with CPR
D. Deflate the balloon and disconnect

Answer: B

In cardiac arrest the IABP 'Trigger Arrest' alarm prompts switching to Arterial Pressure Trigger. If arterial pressure is insufficient, use Internal Trigger (last resort; prevents thrombus). At ROSC, return to ECG/arterial trigger mode.

QUESTION 3

The Impella device works by drawing blood from where and delivering it where?

A. Right atrium to pulmonary artery
B. Left ventricle to aortic root via axial flow pump across the aortic valve
C. Left atrium to aorta via transseptal puncture
D. Right atrium to aorta via ECMO circuit

Answer: B

The Impella is an axial flow pump inserted via femoral artery, advanced retrograde across the aortic valve, drawing blood from the LV to the aortic root. TandemHeart is LA-to-aorta (transseptal). ECMO is RA-to-aorta.

12 Cardiac Arrest Systems of Care

Epidemiology

Out-of-hospital cardiac arrest (OHCA): ~166,000–450,000/year in the US
Survival to hospital discharge: **~5–10%**
VF as initial rhythm: **24–60%** of cases (the shockable proportion)
Majority of OHCA occurs in **residential settings** (not public)

Chain of Survival

Early recognition + activation of EMS
Dispatch + prearrival instructions (PAI) / dispatcher-assisted CPR
Bystander CPR
Public Access Defibrillation (PAD)
First responder BLS (with defibrillation)
ALS care
Post-arrest care (hospital)

Bystander CPR and Dispatch

Dispatcher-assisted CPR instructions improve rates and quality of bystander CPR
Compression-only CPR: practical for bystanders; reduces reluctance; earlier compressions
Emphasis: compressions > ventilations at all levels of care

Public Access Defibrillation (PAD)

70–80% of VF successfully converted if shocked **within 3 min** of onset
Survival decreases **7–10% per minute** of VF without defibrillation
AED + CPR doubles survival vs. CPR alone (ROC data)
Casino study: 53% overall survival from VF; **74% if shocked within 3 min**
AEDs: safe, accurate, do not deliver inappropriate shocks; equipped with memory/recording modules
AED Program Requirements:
Registration with dispatch centers
Notification system for on-site responders
Trained responder selection
Maintenance + annual plan review + QI incident review
Smartphone AED locator apps can integrate with local response systems

BLS vs. ALS Contribution to Survival

BLS (early defib + CPR) is the primary driver of survival from OHCA
OPALS study: increasing BLS response <8 min improved survival from **3.9% → 5.2%**
ALS: despite historical emphasis, ALS is now recognized as **secondary in importance** to BLS and bystander response for overall survival
High-quality CPR and early defibrillation outweigh ALS drug administration

"Frame of Survival" (Developing Systems)

Key community factors that influence OHCA outcomes:
Political commitment and legislative environment
Cultural willingness to help strangers
Reliable telecommunications
Culture of QI and excellence
EMS leadership and EMS–hospital relationships
Traffic/road access
Bystander pool + CPR/AED literacy

PRIORITY PATCH

- ▸ Early CPR + early defibrillation are the only interventions with proven survival benefit in OHCA.
- ▸ Survival drops 7-10% per minute of VF without defibrillation. AED within 3 min: 70-80% conversion rate.
- ▸ Agonal breathing is frequently mistaken for normal breathing. Dispatch algorithms now flag it as arrest.
- ▸ Casino study: 74% survival from VF when shocked within 3 min. Overall OHCA survival: 5-10%.
- ▸ Compression-only CPR: appropriate for bystanders; reduces reluctance and gets compressions started faster.

⚡PULSE CHECK

QUESTION 1

In the casino study, what was the survival rate from VF when defibrillation was performed within 3 minutes?

A. 20--25%
B. 35--40%
C. 53--74%
D. 85--90%

Answer: C

The casino study: 53% overall VF survival; 74% when shocked within 3 minutes. Survival decreases 7--10% per minute without defibrillation. AED plus CPR doubles survival versus CPR alone.

QUESTION 2

The OPALS study demonstrated that BLS response times under 8 minutes improved OHCA survival from approximately 3.5% to:

A. 7.5%
B. 5.2%
C. 8.4%
D. 12%

Answer: B

OPALS: BLS response under 8 minutes improved survival in Phase I from 3.5% overall survival to 5.2%. This reinforced that early BLS (CPR and defibrillation), *not* ALS, is the primary driver of OHCA survival.

QUESTION 3

Which of the following is NOT a required component of an AED program?

A. Registration with dispatch centers
B. On-site physician during all public events
C. Notification system for on-site responders
D. QI incident review and annual maintenance

Answer: B

AED programs do not require on-site physicians. Required elements: registration with dispatch, notification systems, trained responder selection, maintenance plan review, and QI incident review. AEDs are safe, accurate, and have memory/recording modules.

13 Cardiac Arrest: Clinical Management

Chest Compressions: The Foundation

Coronary perfusion pressure (CPP) >20 mmHg required for ROSC
Emphasis on early, continuous, high-quality compressions with minimal interruption
Optimal parameters:
Rate: **100–120/min**
Depth: **≥2 inches (5 cm)** in adults; **≥1.5 inches** in children
Full chest recoil between compressions
CCF (chest compression fraction) ≥60% during resuscitation
Change compressors every **100–200 compressions** (or ~2 min) to maintain quality
Mechanical CPR devices (AutoPulse, LUCAS): provide consistent quality but no demonstrated outcome benefit over high-quality manual CPR

Defibrillation

Time-sensitive, highest-priority intervention for shockable rhythms (VF/pulseless VT)
Continue compressions until moment of shock; resume immediately after
Biphasic defibrillators preferred → current flows in both directions → higher ROSC rates vs. monophasic
Precharge defibrillator while compressions ongoing to minimize hands-off time ("pit crew")
CPR-first vs. shock-first:
Immediate defib: clinician-witnessed arrest OR defibrillator immediately available
~2 min CPR before rhythm analysis: unwitnessed or unknown duration arrest
Largest RCT: no difference in good neurologic outcome between strategies

Airway Management

Airway management is secondary to compressions and defibrillation
Every airway attempt risks CPR interruption
Complications of ETI in arrest: tube misplacement, dislodgement, inadvertent hyperventilation (↑intrathoracic pressure → ↓CPP), multiple laryngoscopy attempts
Options:
BVM: adequate but difficult prehospitally (floor, moving stretcher)
Supraglottic airway (King LT, iGel): blind insertion, minimal CPR interruption; increasing adoption
AIRWAYS-2 trial: iGel vs ETI → no difference in survival or neurologic outcome
King LT trial: higher survival + neurologic outcome vs. ETI (note: ETI success only 52% in that system)
ETI: preferred in systems with high first-pass success rates

Ventilation

Minimize ventilations: 8–10 breaths/min after advanced airway placement
Hyperventilation → ↑intrathoracic pressure → ↓venous return → ↓CPP
Compression-only CPR: appropriate for bystanders; not clearly sufficient for EMS providers
Impedance Threshold Device (ITD): one-way valve during CPR; theoretically ↑CPP: not shown to improve outcomes in large trials

Medications in Cardiac Arrest

No drug has demonstrated improved long-term neurologic survival in OHCA
Epinephrine 1 mg IV/IO q3–5 min: ↑ROSC; no proven long-term survival benefit
Amiodarone or lidocaine: for shock-refractory VF/VT
Vasopressin: removed from most algorithms (no advantage over epinephrine)
Treat reversible causes (H's and T's) aggressively
Reversible Causes of Cardiac Arrest (H's and T's)

H's	T's
Hypovolemia	Tension pneumothorax
Hypoxia	Tamponade (cardiac)
Hydrogen ion (acidosis)	Toxins
Hypo/Hyperkalemia	Thrombosis (PE, MI)
Hypothermia	Trauma

High-Performance CPR ("Pit Crew" Model)

Preassigned roles before arrival
Continuous compressions with minimal pauses
Defibrillator pre-charged during final compressions before rhythm check
Airway and IV/IO access performed without interrupting compressions
Rotate compressors every 2 min
Real-time feedback devices (CPR feedback accelerometers) improve quality

Termination of Resuscitation (TOR)

Non-initiation criteria:
Valid DNR/POLST in place
Clear signs of irreversible death (rigor mortis, lividity, decapitation, etc.)
Verbeek/Morrison BLS TOR Rule (unwitnessed arrest):
No ROSC
No shock delivered
Arrest not witnessed by EMS
→ If all three: termination in field is appropriate
Direct medical oversight is valuable for borderline cases; protocols should address non-obvious situations.

Post-Arrest Care

Goals (prehospital to hospital continuum):
Maintain hemodynamic stability (target SBP ≥90, MAP ≥65)
Preserve brain function
Correct metabolic derangements
Consider targeted temperature management (TTM)
Therapeutic Hypothermia / TTM:
AHA Class I: comatose survivors of OHCA due to **VF/pVT**
AHA Class IIb: comatose survivors with **non-shockable rhythms** (PEA, asystole)
Field cooling: no evidence of benefit from initiating cooling in the prehospital setting
Hospital TTM: 32–36°C for 24 hours; avoid fever (>37.5°C) in post-arrest patients

PRIORITY PATCH

▸ No drug has shown improved long-term neurologic survival in OHCA. Epi increases ROSC but not meaningful survival.
▸ Airway choice in arrest: match to system ETI success rate. Low success rate → SGA first.
▸ TTM: Class I for VF/VT arrest, IIb for non-shockable. Do not initiate cooling in the field.
▸ BLS TOR rule (all three required): no ROSC, no shock delivered, arrest not witnessed by EMS.
▸ CCF ≥60% is the target. Pre-charge defib during last 30 seconds of compressions to minimize hands-off time.
Hypovolemia, Hypoxia, H^+ (acidosis), Hypo/Hyperkalemia, Hypothermia
Tension PTX, Tamponade, Toxins, Thrombosis (PE/MI), Trauma

⚡PULSE CHECK

QUESTION 1

What minimum coronary perfusion pressure is required for ROSC during cardiac arrest?

A. >10 mmHg
B. >20 mmHg
C. >40 mmHg
D. >60 mmHg

Answer: B

CPP >20 mmHg is required for ROSC. High-quality chest compressions with minimal interruption are the primary prehospital method to maintain adequate CPP.

QUESTION 2

The AIRWAYS-2 trial comparing iGel to ETI in OHCA found:

A. ETI was superior for neurologically intact survival
B. iGel was superior for airway management time
C. No difference in survival or neurologic outcome
D. iGel significantly increased ROSC rates

Answer: C

AIRWAYS-2 (iGel vs. ETI in OHCA): no difference in survival or neurologic outcome. This supports SGA use in cardiac arrest --- it also enables uninterrupted compressions during placement.

QUESTION 3

What does chest compression fraction (CCF) measure and what is the target?

A. Rate of compressions; target 100--120/min
B. Proportion of resuscitation time that compressions are actively performed; target ≥60%
C. Compression depth relative to chest diameter; target ≥30%
D. Ratio of compressions to ventilations; target 30:2

Answer: B

CCF = proportion of resuscitation time that compressions are actively performed. Target ≥60%. Change compressors every 100--200 compressions (~2 min) to maintain quality.

14 The Challenge of the Undifferentiated Patient

Core Concept

EMS must compile massive clinical information rapidly with limited tools
Undifferentiated presentations increase risk of medical error and compromised patient safety
Three possible outcomes after history: (1) identifiable chief complaint, (2) accurate diagnosis that's not the dispatch complaint, (3) truly undifferentiated: the hardest case

Modes of Clinical Decision Making

Pattern recognition / skill-based: clinical gestalt; often unconscious, automatic, experience-driven
Rule-based: algorithms (e.g., ACLS protocols); error occurs when wrong rule is chosen
Hypothetical-deductive / knowledge-based: highest level; generate hypothesis, test against data
Naturalistic / event-driven: treat first, diagnose later (4th model recognized by some experts)

Classification of Clinical Errors

By cognitive performance model:
Skill-based errors: slips; failure to execute intended action (e.g., esophageal intubation)
Rule-based errors: wrong rule selected or misapplied
Knowledge-based errors: lack of knowledge or misinterpretation
Alternative approach:
Procedural errors: IV starts, intubations
Cognitive errors: wrong diagnosis, wrong management, wrong disposition
Affective errors: emotional state unduly influences decision-making
Sources of diagnostic error:
No-fault: atypical presentation, uncooperative patient, patient misrepresenting condition
System: interruptions, stress, equipment failure, organizational failures
Cognitive: any error in the line of medical inquiry

Strategies to Minimize Error

Avoid anchoring on prior diagnosis: collect your own history and exam
Minimize personal and external biases
Always check vital signs carefully
Avoid premature closure when diagnosis is uncertain
Be especially careful with: high-acuity/high-volume times, hostile or intoxicated patients, and presentations that don't match the working diagnosis

EMS Approach to the Undifferentiated Patient

Optimize history: use bystanders, family, next of kin; use adjuncts (diagrams, simple language)
Scan the environment: medications, paraphernalia, medical devices, pets
Perform a thorough physical exam when history is limited
Use prehospital diagnostic tests: glucometry, 12-lead ECG
If truly undifferentiated at handoff → clearly communicate this to ED team with what was done and what next steps may be needed

PRIORITY PATCH

- ▸ Three error types: skill-based (slips), rule-based (wrong algorithm), knowledge-based (gap in knowledge).
- ▸ Cognitive bias is the most common source of diagnostic error in EMS. Anchoring is a classic exam trap.
- ▸ Affective errors: emotional state unduly influences decision. Recognize it in yourself and your team.
- ▸ Naturalistic (event-driven) model: treat first, diagnose later. Appropriate for time-critical presentations.

⚡PULSE CHECK

QUESTION 1

An experienced paramedic instantaneously identifies a patient as septic based on overall clinical gestalt without consciously analyzing each finding. This is which decision-making mode?

A. Knowledge-based (hypothetical-deductive) reasoning
B. Rule-based reasoning
C. Pattern recognition (skill-based) reasoning
D. Affective error

Answer: C

Pattern recognition/skill-based reasoning is automatic, experience-driven clinical gestalt --- often unconscious. Rule-based uses algorithms (ACLS). Knowledge-based is the highest level. Affective errors occur when emotional state unduly influences decisions.

QUESTION 2

A paramedic accepts a prior psychiatric diagnosis and fails to independently reassess a patient who is actually hypoglycemic. This exemplifies which cognitive error?

A. Skill-based slip
B. Anchoring/premature closure
C. Rule-based error
D. System error

Answer: B

Anchoring/premature closure: accepting an initial diagnosis without adequately reconsidering alternatives. Particularly dangerous in EMS when dispatched with a pre-existing label. Always collect your own history and exam.

QUESTION 3

Affective errors in EMS clinical decision-making are correctly defined as:

A. Executing a wrong algorithm for the situation
B. Failure to perform an intended procedural action
C. Emotional state unduly influencing decision-making
D. Lack of knowledge leading to incorrect diagnosis

Answer: C

Affective errors: emotional state unduly influences clinical decisions. Skill-based errors are slips (failure to execute). Rule-based errors involve wrong rule selection. Knowledge-based errors stem from lack of knowledge or misinterpretation.

15 Altered Mental Status

Overview

AMS = altered alertness, altered content of consciousness, or both
Common EMS presentation; broad differential; patient impaired in giving their own history
Avoid vague terms (stuporous, obtunded): describe specific deficits and timing
Delirium: acute onset, waxing/waning; **Dementia**: gradual, normal arousal

Mnemonic: AEIOU TIPPS

Letter	Causes
A	Alcohol
E	Epilepsy, Electrolytes, Encephalopathy
I	Insulin (hypoglycemia)
O	Oxygen (hypoxia), Overdose
U	Uremia
T	Trauma, Temperature
I	Infection
P	Poisons
P	Psychiatric
S	Shock, Sepsis, Stroke, Space-occupying lesion

Scene Assessment for AMS

Bystanders, family, med-alert bracelets
Medications, empty pill bottles, drug paraphernalia, liquor bottles
Search bathrooms, medicine cabinets, nightstands
Multiple patients or sick/dead pets → consider CO poisoning
Ask about LOC, seizure-like activity, route/amount of substance if OD suspected

Level of Responsiveness: AVPU Scale

A: Alert
V: responds to Verbal stimuli
P: responds to Painful stimuli
U: Unresponsive

Pediatric AMS

Subtle: look for age-inappropriate behaviors (irritability, decreased interaction, sleepiness)
Use **Pediatric Assessment Triangle (PAT)**: Appearance, Work of breathing, Circulation
AEIOU TIPPS mnemonic applies to peds too

Special Population: Alcoholic Patient

Don't assume "just drunk": rule out trauma, hypoglycemia, hepatic encephalopathy, withdrawal, overdose, electrolyte abnormalities, infection, seizure, hypothermia

Time-Critical AMS Causes (short scene time, rapid transport)

Trauma (especially head/neck)
STEMI
Positive stroke screen

Key Medications and Antidotes

Dextrose:
Only ~25% of AMS patients are hypoglycemic: don't give empirically
D50 raises glucose average 166 mg/dL but varies widely
D10 preferred: same time to euglycemia, 15g less glucose, fewer hyperglycemic events, less sclerosing
Risks of D50: skin necrosis with extravasation, hyperosmolality, hyperkalemia, worsened neurological outcomes in ischemic patients

Naloxone:
Titrate in small doses (start 0.4 mg) to respiratory improvement: avoid precipitating withdrawal
Synthetic/semi-synthetic opioids and naive heroin users may require higher doses
Routes: IV, IM, IN, IO: all similarly effective prehospital
Avoid early advanced airway in opioid OD: give naloxone first
Flumazenil:
Avoid: may precipitate seizures in patients with chronic benzo use or EtOH dependence
Use supportive care instead

Criteria for Non-Transport After Treated Hypoglycemia

History of IDDM; not on long-acting insulin or oral hypoglycemics
Post-treatment glucose 80–100 mg/dL
Return to normal mental status + tolerating PO in front of EMS
Responsible adult present
No complicating factors
Written follow-up instructions; direct medical oversight available

Criteria for Non-Transport After Treated Opioid OD

Isolated IV heroin; no oral or long-acting opioid involved
Not in cardiac arrest; naloxone only used for AMS/respiratory depression
≤ 2 mg naloxone used to normalize mental status
Patient consents to additional naloxone dose or has take-home naloxone available
Responsible adult present

PRIORITY PATCH

▸ D10 preferred over D50: same time to euglycemia, less hyperglycemia, less sclerosing to veins.
▸ Only ~25% of AMS patients are hypoglycemic. Check glucose before giving dextrose empirically.
▸ Naloxone: titrate to respiratory improvement, not full wakefulness. Precipitating withdrawal is dangerous.
▸ Flumazenil: avoid in chronic benzo users or EtOH dependence. Risk of seizures.
▸ Non-transport after treated hypoglycemia requires: IDDM, not on long-acting agents, glucose 80-100, normal MS, PO tolerated, responsible adult present.
Alcohol, Epilepsy/Electrolytes, Insulin, Oxygen/Overdose, Uremia
Trauma/Temp, Infection, Poisons, Psychiatric, Shock/Stroke/Space-occupying

⚡PULSE CHECK

QUESTION 1

In the AEIOU TIPPS mnemonic, what does the second 'I' represent?

A. Intoxication
B. Ischemia
C. Infection
D. Intracranial hemorrhage

Answer: C

AEIOU TIPPS: A=Alcohol, E=Epilepsy/Electrolytes/Encephalopathy, I=Insulin (hypoglycemia), O=Oxygen/Overdose, U=Uremia, T=Trauma/Temperature, I=Infection, P=Poisons, P=Psychiatric, S=Shock/Sepsis/Stroke/Space-occupying lesion.

QUESTION 2

Multiple patients with AMS and a dead pet found at the scene should raise immediate suspicion for which condition?

A. Organophosphate poisoning
B. Meningococcal meningitis outbreak
C. Carbon monoxide poisoning
D. Serotonin syndrome

Answer: C

Multiple patients with AMS or sick/dead pets = carbon monoxide poisoning until proven otherwise. Scene assessment for AMS includes checking for CO sources, pill bottles, med-alert bracelets, and drug paraphernalia.

QUESTION 3

D10W is increasingly preferred over D50W for prehospital hypoglycemia. The primary reason is:

A. D10W achieves euglycemia faster
B. D10W avoids all risk of rebound hypoglycemia
C. D10W causes fewer hyperglycemic events and is less sclerosing
D. D10W requires smaller volume for same glucose elevation

Answer: C

D10W achieves the same time to euglycemia as D50W but with fewer hyperglycemic overshoot events, less sclerosing potential, and 15g less glucose per dose. D50W carries risk of extravasation necrosis.

16 Syncope

Definition

Transient loss of consciousness AND postural tone from diminished cerebral blood flow, with **spontaneous return** to normal mental status

Must involve both cerebral hemispheres simultaneously OR the reticular activating system in the brainstem

Self-corrects without external intervention. Patient requiring IV dextrose to wake up did NOT have true syncope.

Causes and Frequency

Category	Frequency	Key Features
Reflex-mediated	35-58%	Best prognosis; vasovagal, orthostatic, carotid sinus
Idiopathic	~35%	No cause found even after workup
Cardiac	~20%	Most dangerous; often NO findings on EMS arrival
Neurological	~10%	TIA, SAH, migraine: rare cause of pure syncope

Cardiac Causes: High-Yield

Most common dysrhythmia: transient VT. Often in patients with CHF and low EF (1-year mortality up to 40%)

Other dysrhythmias: severe sinus bradycardia, high-grade AV blocks, sick sinus syndrome, SVT, A-fib with RVR (all must be paroxysmal to cause syncope)

Structural causes: severe AS, mitral regurgitation, PE, restrictive CMP, atrial myxoma, aortic dissection, pericardial tamponade

Congenital prolonged QT: check QTc on every syncope patient. Young patient + exertional syncope = long QT until proven otherwise.

Assessment

History is the most important tool. EMS may be the only clinicians who can interview witnesses at the scene.

High-yield questions: any prodrome? palpitations or chest pain before? no warning at all? (no prodrome = cardiac red flag)

Recovery time matters: true syncope returns to normal in under 30 seconds; seizure postictal lasts minutes

Physical exam is **often completely normal at time of EMS arrival**. Normal exam does NOT rule out cardiac cause.

Check glucose. Low glucose rarely causes true syncope, but must rule out.

12-lead ECG: only Class I recommendation for in-hospital syncope workup. Get it prehospital.

ECG Findings Diagnostic for Dysrhythmic Syncope

Sinus bradycardia persistently below 40 bpm

Sinus pauses over 3 seconds

Mobitz II second-degree AV block

Third-degree (complete) heart block

Alternating LBBB and RBBB

Ventricular tachycardia

Rapid paroxysmal SVT

Pacemaker or AICD dysfunction

Differential Diagnosis

Condition	Key Distinguisher
Seizure (most common mimic)	Postictal period lasting minutes; absent in syncope
Post-syncope myoclonic jerks	Mimic seizure; no postictal period, brief duration
Pseudosyncope	Psychiatric; no actual LOC; do NOT confront on scene
Cataplexy	Loss of postural tone without LOC
Hypoglycemia	Requires intervention to correct; not true syncope

Management and Disposition

Supine position: improves cerebral perfusion; most episodes resolve before EMS arrival

Cardiac monitoring and IV access if dysrhythmia suspected; IV fluids for orthostatic or hypovolemic cause

Transport to closest facility is usually appropriate. Rare causes needing specialty centers (SAH, STEMI) are typically NOT asymptomatic.
Refusing patient: confirm decision-making capacity, explain cardiac risks explicitly; document thoroughly
Exam Trap:
A patient woke up after IV dextrose: that is NOT syncope. Syncope self-corrects without intervention.
Post-syncope myoclonic jerks do NOT confirm a seizure diagnosis. The postictal period is the key distinguisher.
Normal ECG and normal physical exam on EMS arrival do NOT rule out a cardiac cause. Cardiac syncope often presents with a completely normal exam.
Do NOT confront a patient you suspect of pseudosyncope on scene. It disrupts the therapeutic relationship in an uncontrolled environment.

PRIORITY PATCH

► Syncope requires NO external intervention to correct. If patient needed dextrose or naloxone to wake up, it is not syncope.
► Most common dysrhythmia causing syncope: transient VT. CHF + low EF + syncope = up to 40% 1-year mortality.
► No-prodrome syncope = cardiac red flag. EMS witness interview at the scene is often irreplaceable.
► 12-lead ECG is the only Class I recommendation for syncope evaluation. Normal ECG does not rule out cardiac cause.
► Post-syncope myoclonus does NOT equal seizure. Seizure = postictal period lasting minutes; syncope recovery under 30 seconds.

⚡PULSE CHECK

QUESTION 1

A 19-year-old collapses during basketball without warning and has a prolonged QTc on ECG. What is the most likely diagnosis?

A. Vasovagal syncope
B. Hypertrophic obstructive cardiomyopathy
C. Congenital prolonged QT syndrome
D. Orthostatic hypotension

Answer: C

Young patient + exertional syncope = long QT until proven otherwise. Check QTc on every syncope patient. Prolonged QT can cause torsades de pointes progressing to VF. Cardiac syncope is the most dangerous category.

QUESTION 2

A patient required IV dextrose to regain consciousness after a witnessed LOC. By definition, this patient:

A. Had true syncope triggered by hypoglycemia
B. Did NOT have true syncope
C. Experienced a reflex-mediated syncopal episode
D. Requires urgent cardiac workup for cardiac syncope

Answer: B

True syncope requires spontaneous return to normal mental status without external intervention. A patient requiring dextrose did NOT have true syncope --- this was hypoglycemia-induced LOC. This distinction is directly tested.

QUESTION 3

Which cause of syncope carries the worst prognosis?

A. Reflex-mediated (vasovagal)
B. Idiopathic
C. Cardiac
D. Neurological

Answer: C

Cardiac syncope has the worst prognosis --- up to 40% 1-year mortality when caused by transient VT with low EF. Reflex-mediated (35--58% of cases) has the best prognosis. Normal exam at EMS arrival does NOT rule out cardiac cause.

17 Seizures

Pathophysiology

Excess neuronal excitation (glutamate) + failure of inhibition (GABA) → prolonged firing
Originate from cerebral cortex or thalamus
Key distinction: **symptomatic (provoked)** vs. **unprovoked** seizure

Definition: Status Epilepticus

Seizure lasting ≥5 minutes, OR
Multiple seizures without return to baseline consciousness between episodes
Ongoing electrical activity is itself injurious to the brain: time matters

Common Causes (Provoked Seizures)

Electrolyte abnormalities (hyponatremia, hypoglycemia)
Medication or medication withdrawal (benzos, EtOH, antiepileptics)
Toxins
CNS or systemic infections
Hypoxia
Trauma
Sleep deprivation
Pregnancy (eclampsia)

Febrile Seizures

Age: 6 months–5 years (peak 18 months): maturing brain
No other identified cause for seizure
Simple febrile seizure: generalized tonic-clonic, <10 minutes, not recurring in 24 hours: resolves spontaneously; usually ceased by EMS arrival
Complex febrile seizure: focal features, >10 minutes, OR recurs within 24 hours
Postictal >60 min → consider complicating condition
Magnitude/peak of fever more important than rate of rise; antipyretics do NOT prevent febrile seizures

EMS Approach to Active Seizures

Protect the patient: cushion the head, move hard objects away, do NOT restrain
Airway: NPA often adequate (patient may not tolerate OPA); lateral decubitus if no spinal concern
Oxygen: supplemental O2
Glucose: rapid check; treat hypoglycemia if present; give thiamine if malnourished
Vascular access
Benzodiazepines: first-line pharmacologic treatment

Benzodiazepine Dosing for Status Epilepticus

Drug	Route	Adult Dose	Max
Lorazepam (Ativan)	IV	0.1–0.15 mg/kg	4 mg (up to 8 mg per 3rd ed)
Midazolam (Versed)	IM	10 mg (>40 kg); 5 mg (13–40 kg)	10 mg
Midazolam	IV/IN	0.2 mg/kg	10 mg
Diazepam (Valium)	IV	0.2 mg/kg at 5 mg/min	20 mg adult; 10 mg peds
Diazepam	PR	0.5 mg/kg	—

RAMPART Study

IM midazolam = IV lorazepam for prehospital status epilepticus
IM route faster (no IV access needed) with similar adverse events

Second-Line Agents (ESETT Trial)

Phenytoin/fosphenytoin, valproate, levetiracetam: all equivalent efficacy for benzo-refractory status
Typically not on standard EMS units; may be available for critical care transport or EMS physician units

Refractory SE

Fails optimal benzos + second-line agent

Options include propofol, ketamine, midazolam infusion: requires RSI and airway management

Spinal Immobilization

Probably unnecessary unless significant associated trauma

Seizures very rarely cause cervical fractures without major traumatic mechanism

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Key Numbers: *SE = 5 minutes OR multiple without recovery to baseline. Postictal >30 minutes → think complication.*

PRIORITY PATCH

RAMPART = IM midazolam as good as IV lorazepam for field status epilepticus. Know this one.
Simple febrile seizure = generalized, <10 min, only once in 24 hours. Any deviation = complex.

⚡PULSE CHECK

QUESTION 1

Status epilepticus is defined as:

A. Any seizure lasting more than 10 minutes
B. Seizure lasting ≥5 minutes OR multiple seizures without return to baseline between episodes
C. Any focal seizure regardless of duration
D. Seizure unresponsive to one benzodiazepine dose

Answer: B

Status epilepticus: seizure ≥5 minutes OR multiple seizures without return to baseline between episodes. Ongoing electrical activity is itself injurious --- time to treatment is critical.

QUESTION 2

For prehospital status epilepticus management, midazolam IM dosing for patients over 40 kg is:

A. 5 mg IM
B. 10 mg IM
C. 0.2 mg/kg IM (max 4 mg)
D. 0.1 mg/kg IM (max 2 mg)

Answer: B

Midazolam IM: 10 mg for patients >40 kg; 5 mg for 13--40 kg. IM midazolam is preferred prehospitally when IV access is not immediately available. Lorazepam IV: 0.1--0.15 mg/kg (up to 4--8 mg). IM route achieves faster onset than IV in many field scenarios.

QUESTION 3

Antipyretics in febrile seizure management:

A. Prevent recurrence of febrile seizures
B. Reduce severity of febrile seizures
C. Do NOT prevent febrile seizures
D. Are contraindicated in febrile seizures

Answer: C

Antipyretics do NOT prevent febrile seizures --- the magnitude/peak of fever matters more than rate of rise. Simple febrile seizures (generalized, <10 min, non-recurring) typically self-terminate before EMS arrival. Transport is still appropriate.

18 Stroke

Epidemiology

Stroke = 1 in every 19 deaths in the US; **5th leading cause of death**
Leading cause of adult disability
Ischemic: ~87%; Hemorrhagic: ~13% (10% ICH, 3% SAH)
Dispatchers correctly identify stroke only **31–52%** of the time; caller use of the word "stroke" is highly predictive
Falls cited as primary complaint in ~21% of stroke dispatches

Key Definitions

Ischemic penumbra: tissue surrounding core infarct with reduced (but not absent) blood flow; salvageable if reperfused in time
TIA: neurological deficit lasting minutes to 24 hours; 10–20% risk of stroke in next 90 days, half within 24–48 hours
"Time is brain": every minute of major ischemic stroke, approximately 1.9 million neurons are lost

Stroke Mimics (Know These)

Complex migraine
Conversion disorder
Encephalopathy (metabolic, hypertensive)
Hypoglycemia: always check glucose
Labyrinthitis
Meniere disease
Todd's paralysis: postictal focal weakness
Ramsay-Hunt syndrome
Sepsis/infection

Prehospital Management

Last known well time is essential: document precisely; this drives thrombolytic eligibility
ABCs: airway management; avoid hypoxia
Supplemental O2 only to maintain SpO2 ≥ 94% (hyperoxia may worsen outcomes)
Treat reversible conditions (especially hypoglycemia)
Continuous cardiac monitoring: stroke patients at risk for dysrhythmias due to catecholamine surge; AF may be cause OR consequence
Blood pressure management: prehospital BP control is controversial; hypotension may reduce penumbral perfusion; best managed definitively in ED

tPA: Time Windows

IV tPA: **up to 4.5 hours** from symptom onset (AHA/ASA guideline)
Benefit decreases with time:
0–90 min from onset: OR 2.6 for good outcome (NNT 4.5)
91–180 min: OR 1.6 (NNT 9)
181–270 min: OR 1.3 (NNT 14.1)
Door-to-needle goal: ≤60 minutes

Endovascular Thrombectomy (LVO)

DEFUSE-3 trial: thrombectomy 6–16 hours from last known well → 45% functional independence vs. 17% standard care
DAWN trial: thrombectomy 6–24 hours from last known well → 49% functional independence vs. 13%
EMS increasingly expected to identify LVO candidates for transport to comprehensive stroke centers

Prehospital Stroke Scales

Cincinnati Prehospital Stroke Scale (CPSS)
Facial droop, Arm drift, Abnormal speech
Any 1 of 3 abnormal = positive screen
CPSS = 3 (all abnormal): 72.7% had LVO in one study
Los Angeles Prehospital Stroke Screen (LAPSS)
Age >45, no seizure history, symptoms <24 hrs, not bedridden, glucose 60–400, unilateral motor deficit
More specific than CPSS
Melbourne Ambulance Stroke Screen (MASS)
Hybrid of Cincinnati and LAPSS

RACE Scale (Rapid Arterial oCclusion Evaluation)
Scores facial palsy, arm/leg motor function, gaze deviation, aphasia/agnosia
RACE ≥5: sensitivity 66%, specificity 72% for LVO
Score 0–9
B-FAST / BE-FAST (public education tool, not a validated prehospital scale)
Balance, Eyes, Face, Arm, Speech, Time

EMS Destination

Prehospital notification significantly reduces door-to-CT and door-to-needle times
One study: EMS notification increased tPA eligibility from 4.3% to 28.6%
Know local stroke center capabilities: not all facilities can do thrombectomy

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Key Numbers: *tPA window = 4.5 hours. Thrombectomy (DAWN) = up to 24 hours from last known well. Door-to-needle goal = 60 minutes.*

PRIORITY PATCH

Last known well time, not symptom onset time, drives thrombolytic eligibility. If the patient woke up with symptoms, last known well = when they last went to bed.
There are many LVO scales: none is perfect. Know CPSS and LAPSS by name; know RACE exists for LVO screening.

⚡PULSE CHECK

QUESTION 1

Every minute of untreated major ischemic stroke results in loss of approximately how many neurons?

A. 500,000
B. 1.9 million
C. 5 million
D. 10 million

Answer: B

'Time is brain' --- approximately 1.9 million neurons per minute. Dispatchers correctly identify stroke only 31--52% of the time. Falls are cited as the primary complaint in approximately 21% of stroke dispatches.

QUESTION 2

Which condition is the most important reversible stroke mimic to check and treat prehospitally?

A. Complex migraine
B. Todd's paralysis
C. Hypoglycemia
D. Conversion disorder

Answer: C

Hypoglycemia is the most important and common reversible stroke mimic. Always check glucose in any suspected stroke. Other mimics: complex migraine, Todd's paralysis (postictal focal weakness), labyrinthitis, and sepsis.

QUESTION 3

IV tPA for ischemic stroke provides benefit up to how many hours from symptom onset?

A. 3.0 hours
B. 4.5 hours
C. 6.0 hours
D. 24 hours

Answer: B

IV tPA is indicated up to 4.5 hours from symptom onset per AHA/ASA guidelines. Benefit decreases with time (NNT 4.5 at 0--90 min vs. NNT 14.1 at 181--270 min). Last known well time must be documented precisely prehospitally.

19 Abdominal Pain

Epidemiology

~5% of EMS calls
Undertriage by EMS is common: sensitivity for serious pathology as low as 11–22%

Three Mechanisms of Pain

Visceral: hollow or solid organ; poorly localized; often with autonomic symptoms (nausea, vomiting, anorexia)
Somatic: peritoneal lining; more severe and localized; worse with movement
Referred: pain distant from the actual pathology (e.g., right scapular pain = gallbladder; left shoulder pain = splenic or diaphragmatic irritation)

Differential by Population (High-Yield)

Elderly: higher acuity; symptoms often underreported; higher risk of mesenteric ischemia, AAA, perforation
Women of childbearing age: always consider ectopic pregnancy, ovarian torsion, PID
Pediatric: intussusception, malrotation, Meckel's diverticulum
Immunocompromised: atypical and subtle presentations; lower threshold for concern
Obese/bariatric surgery patients: altered anatomy, unique post-op complications
Remember: cardiac, pulmonary, and pleural pathology can present as abdominal pain

History: SAMPLE + OPQRST

SAMPLE: Signs/Symptoms, Allergies, Meds, Past medical history, Last meal, Events leading to call
OPQRST: Onset, Palliation/Provocation, Quality, Radiation, Severity, Time

Physical Exam

Vitals often normal: do not be falsely reassured
Palpate all 4 quadrants
Elicit peritoneal signs: rebound, guarding, heel tap
Assess for rigidity (peritonitis)

Treatment

Treat supportively. There is no definitive prehospital treatment for most causes of abdominal pain. Always get a 12-lead ECG: inferior MI can present as abdominal pain. Do not withhold analgesia prehospitally.

PRIORITY PATCH

Most prehospital abdominal pain is undifferentiated — do not withhold analgesia for fear of masking the diagnosis; this is not supported by evidence
Visceral pain = diffuse, crampy; parietal pain = sharp, localized (peritoneal irritation); referred pain = distant site (e.g., diaphragm irritation → shoulder)
Peritoneal signs (rigidity, rebound, guarding) = surgical emergency until proven otherwise; transport without delay
AAA triad: hypotension + back/flank pain + pulsatile mass; most present without all three; high index of suspicion in elderly men
Ectopic pregnancy: any woman of reproductive age with abdominal pain + vaginal bleeding until proven otherwise; can rupture rapidly

⚡PULSE CHECK

QUESTION 1

Which additional assessment step is most critical in an elderly male with abdominal pain and diaphoresis?

A. Palpate all four quadrants for peritoneal signs
B. Obtain a 12-lead ECG
C. Check blood glucose
D. Assess for flank tenderness

Answer: B

A 12-lead ECG is critical because inferior MI can present as abdominal pain --- a classic exam trap. Always obtain an ECG for abdominal pain. Do not withhold analgesia prehospitally; effective pain relief does not obscure the diagnosis.

QUESTION 2

Pain that is poorly localized and associated with nausea, vomiting, and autonomic symptoms originates from which pain mechanism?

A. Somatic pain
B. Visceral pain
C. Referred pain
D. Neuropathic pain

Answer: B

Visceral pain from hollow or solid organs is poorly localized and often associated with autonomic symptoms (nausea, vomiting, anorexia). Somatic pain (peritoneal lining) is severe and localized. Referred pain is distant from the pathology.

QUESTION 3

EMS sensitivity for identifying serious pathology in abdominal pain calls is approximately:

A. 50--60%
B. 70--80%
C. 11--22%
D. 85--95%

Answer: C

EMS sensitivity for serious abdominal pathology is as low as 11--22% --- undertriage is common. Vitals are often normal despite serious pathology. Transport is the appropriate disposition for most abdominal pain calls.

20 Diabetic Emergencies

Epidemiology

~11% of US population has DM; 90–95% Type II; many undiagnosed
EMS most commonly called for **hypoglycemia**: most urgent, immediately reversible
Hyperglycemia calls: DKA (usually Type 1), HHS (usually Type 2)

Hypoglycemia

Definition: Blood glucose <70 mg/dL (with symptoms)
Symptoms:
Mild: diaphoresis, tremor, anxiety, palpitations, hunger
Moderate/severe: AMS, combativeness, seizure, coma
Treatment Options:
Hypoglycemia: Prehospital Treatment Options

Option	Notes
Oral glucose	Alert patients with intact swallow only
IV D50	Standard; avg ↑ 166 mg/dL (range 37–370); risk of extravasation necrosis
IV D10	Same time to euglycemia; 15g less glucose; fewer hyperglycemic events; less sclerosing; becoming preferred
IM/IN/SC Glucagon	For no IV access; slower (8–21 min response); less effective in alcoholics/malnourished (depleted glycogen)
Intranasal Glucagon	Comparable efficacy to IM; faster/easier to use; now FDA-approved
IO Dextrose	Last resort; infection risk in diabetics

Pediatric Note: Dilute dextrose to at least D25W (D10W also effective and preferred in some systems)

Safe Refusal Criteria After Prehospital Hypoglycemia Treatment

Return to baseline mental status
Tolerating PO intake in front of EMS
Responsible adult present
No condition predisposing to repeat episode
Not on long-acting insulin or oral hypoglycemics (sulfonylureas)
Post-treatment glucose 80-100 mg/dL
Written instructions to follow up with physician
Patient and family understand return precautions

Hyperglycemia

DKA (Diabetic Ketoacidosis):
Glucose usually >250 mg/dL with acidosis and ketosis
Typically Type 1 diabetics (or Type 2 under severe metabolic stress)
Precipitants: infection, MI, pregnancy, trauma, missed insulin
Signs: Kussmaul respirations, fruity breath, dehydration, N/V, abdominal pain, AMS
DKA mortality has fallen from 100% (pre-insulin era) to <1% in developed countries
EMS treatment: IV fluid resuscitation for hemodynamic stabilization; no prehospital insulin
Pediatric DKA: high risk of life-threatening cerebral edema with rapid volume repletion → resuscitate only enough to reverse shock/hypotension; definitive fluid/insulin correction over 24–48 hours in hospital
HHS (Hyperosmolar Hyperglycemic State):
Glucose usually >600 mg/dL, minimal or no ketosis
More common in Type 2 diabetics
Mortality as high as **10–20%** (far higher than DKA)
Severe dehydration → aggressive IV fluid resuscitation without delay
EMS cannot reliably differentiate DKA from HHS: treat hemodynamically

Key Numbers: *Hypoglycemia <70 mg/dL. Hyperglycemia >200 mg/dL. HHS mortality 10–20% (vs. DKA <1%). Pediatric DKA: fluids slowly: cerebral edema risk.*

PRIORITY PATCH

D10 is preferred over D50 in many modern protocols: same efficacy, safer. Know both.
Glucagon is less effective in malnourished or alcoholic patients (depleted glycogen stores).

⚡PULSE CHECK

QUESTION 1

Which criterion is required for safe refusal of transport after prehospital hypoglycemia treatment?

A. Blood glucose >70 mg/dL after treatment
B. Patient not on long-acting insulin or sulfonylurea agents
C. Patient has had prior hypoglycemic episodes without complications
D. SpO2 >95% with normal vital signs

Answer: B

Not being on long-acting insulin or sulfonylurea agents (which prolong hypoglycemia risk) is a required criterion for safe refusal. All criteria must be met: baseline mental status restored, tolerating PO, responsible adult present, post-treatment glucose 80--100 mg/dL, written instructions given.

QUESTION 2

A Type 1 diabetic has Kussmaul respirations, fruity breath, and glucose of 420 mg/dL. This represents:

A. Hyperosmolar hyperglycemic state (HHS)
B. Diabetic ketoacidosis (DKA)
C. Alcoholic ketoacidosis
D. Lactic acidosis

Answer: B

DKA: glucose typically >250 mg/dL, ketosis, acidosis, Kussmaul respirations, fruity breath. Typically Type 1. HHS: Type 2, extreme hyperglycemia (often >600 mg/dL), severe dehydration, minimal or no ketoacidosis.

QUESTION 3

Glucagon IM/IN is less effective in which patient population?

A. Elderly patients due to decreased receptor sensitivity
B. Malnourished/chronic alcohol users due to depleted hepatic glycogen stores
C. Pediatric patients due to different glucagon receptor distribution
D. Patients on beta-blockers due to receptor antagonism

Answer: B

Glucagon stimulates hepatic glycogenolysis. Malnourished patients and those with chronic alcohol use have depleted glycogen stores, limiting glucagon's effectiveness. IV or IO dextrose is more reliable in these patients.

21 Allergic Reactions

Pathophysiology

Hypersensitivity reactions from allergen exposure
Type I (IgE-mediated) = most anaphylaxis cases: immediate
Type II = transfusions, drug reactions, ITP
Type III = serum sickness, post-strep glomerulonephritis
Type IV = T-cell mediated, delayed; does NOT cause anaphylaxis

Progression of Allergic Reactions

Local reaction → urticaria → angioedema → systemic anaphylaxis → anaphylactic shock → circulatory collapse

Angioedema: Two Types (Critical Distinction)

Histamine-mediated: responds to epi, antihistamines, steroids
Bradykinin-mediated (ACE inhibitor angioedema): does NOT respond to conventional therapy; may occur months-years into ACE-I use; airway protection is the priority

Hereditary Angioedema (HAE)

C1 esterase inhibitor deficiency
Does not respond to epinephrine, antihistamines, steroids
Specific treatments: C1-INH concentrate, icatibant, ecallantide

Common Triggers

Foods: peanuts, tree nuts, shellfish, eggs, wheat
Medications: penicillin, NSAIDs, ACE inhibitors, contrast dye
Insects: Hymenoptera (bees, wasps, hornets, fire ants)
Environmental: latex, mold, pollen

Hymenoptera Notes

Account for most severe anaphylaxis among insects
~1% of children and ~3% of adults have severe systemic reactions
Anaphylaxis can occur **without prior exposure**
If allergic to one Hymenoptera family → likely allergic to others

Treatment: Severity-Guided

Local reaction only: wound care, pain relief, comfort
Systemic allergic reaction / Anaphylaxis:
O2, IV access, cardiac monitor
Epinephrine: first-line, do not delay
IM (preferred route): 0.3 mL of 1:1,000 into lateral thigh (vastus lateralis: highest peak plasma concentration)
Epi IM > Epi SQ (faster absorption due to increased vascularity of lateral thigh)
IV epi: 1 mL of 1:10,000 mixed in 10 mL NS, slow push over 5–10 min: only if hemodynamically unstable
Nebulized: 0.5 mL of 1:1,000 in 2.5 mL NS for airway edema
Caution with IV epi in CAD or life-threatening tachydysrhythmias
Albuterol: nebulized for bronchospasm
Diphenhydramine: 25–50 mg IV/IM/IO/PO (H1 blocker)
H2 blockers: famotidine 20 mg IV or ranitidine 50 mg IV (synergistic with H1 blockade; avoid cimetidine due to drug interactions)
Corticosteroids: methylprednisolone; peak onset 2–4 hours; may prevent biphasic reactions
Glucagon: 1 mg IV/IM increments for patients on **beta-blockers** (overcomes beta-blockade)

Biphasic Reactions

Late-phase reaction occurs hours after initial reaction
Can be more severe than initial reaction: may affect different organ systems
Nearly impossible to predict which patients will have biphasic response
Rationale for hospital transport even if initial reaction resolves

Pediatric Dosing (Key)

Epinephrine 1:1,000 IM: 0.01 mg/kg (max 0.3 mL)

Diphenhydramine: 1 mg/kg (max 50 mg)
Methylprednisolone: 1–2 mg/kg
Famotidine: 0.5 mg/kg (max 20 mg IV/IO)

Destination

Consider subspecialty needs: ENT, anesthesia, critical care, toxicology
Air medical transport if hemodynamically unstable with extended ground transport time

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Key Numbers: *Epi 1:1,000 IM (higher concentration) vs. Epi 1:10,000 IV (lower concentration, slower push). Don't mix these up on the exam.*

Exam Trap:

ACE inhibitor angioedema does NOT respond to epinephrine, antihistamines, or steroids. Airway protection is the priority. Don't waste time on standard anaphylaxis meds.

IV epinephrine is only for hemodynamically unstable patients. IM into the lateral thigh is standard for all others.

Glucagon is the correct answer when anaphylaxis is refractory in a patient on beta-blockers. Not more epi.

Biphasic reactions can be more severe than the initial reaction. This is why all anaphylaxis patients transport, even if the reaction resolves.

PRIORITY PATCH

IM epinephrine into the lateral thigh (vastus lateralis) achieves higher and faster peak plasma concentration than deltoid IM or SQ. Always lateral thigh.
ACE inhibitor angioedema = bradykinin-mediated = does NOT respond to epi/antihistamines/steroids. Know this distinction.
Glucagon for anaphylaxis in beta-blocker patients: 1 mg increments to overcome beta-blockade.

⚡PULSE CHECK

QUESTION 1

A patient on ACE inhibitor therapy for 18 months develops progressive tongue swelling without urticaria. Which statement is most accurate?

A. This is histamine-mediated and will respond to epinephrine
B. This is bradykinin-mediated angioedema and will NOT respond to conventional therapy
C. This is hereditary angioedema requiring C1-INH concentrate
D. This is anaphylaxis requiring immediate IM epinephrine

Answer: B

ACE inhibitor angioedema is bradykinin-mediated and does NOT respond to epinephrine, antihistamines, or steroids. It may occur months to years after starting the ACE inhibitor. Airway protection is the priority. Hereditary angioedema (HAE, C1-INH deficiency) also does not respond to conventional therapy.

QUESTION 2

Regarding Hymenoptera envenomation, which statement is correct?

A. Anaphylaxis requires documented prior exposure
B. Approximately 1% of children and 3% of adults have severe systemic reactions
C. Allergy to one Hymenoptera family is independent from allergy to others
D. Anaphylaxis cannot occur without prior sensitization

Answer: B

Approximately 1% of children and 3% of adults have severe systemic reactions to Hymenoptera. Anaphylaxis CAN occur without prior known exposure. Allergy to one Hymenoptera family predicts likely allergy to others.

QUESTION 3

Which immune mechanism most commonly mediates anaphylaxis?

A. Type II (cytotoxic)
B. Type III (immune complex)
C. Type I (IgE-mediated)
D. Type IV (T-cell mediated, delayed)

Answer: C

Type I (IgE-mediated) hypersensitivity mediates most anaphylaxis --- immediate onset upon re-exposure. Type IV is delayed and does NOT cause anaphylaxis. Types II and III cause other reactions (transfusions, serum sickness).

22 Renal Failure and Dialysis

Kidney Basics

Kidneys receive ~20% of cardiac output
Functions: waste excretion, fluid balance, electrolyte regulation, acid-base balance, hormone production (EPO, renin, active Vitamin D)

Definitions

Acute Kidney Injury (AKI): KDIGO criteria (any one):
Serum creatinine ↑ ≥0.3 mg/dL within 48 hours
Serum creatinine ↑ ≥1.5× baseline within 7 days
Urine output <0.5 mL/kg/hr for ≥6 hours
Causes: Pre-renal (shock, dehydration), Intrinsic (glomerulonephritis, ATN), Post-renal (obstruction)
Chronic Kidney Disease (CKD):
GFR <60 mL/min for >3 months
Most commonly from diabetes and hypertension
African Americans: 3.4× higher incidence of ESRD vs. Caucasians

Dialysis Access Types

AV fistula: surgically created artery-to-vein connection; gold standard; lowest complication rate
AV graft: synthetic connection; more prone to complications than fistula
Tunneled catheter: central vein (usually internal jugular); immediately usable; highest complication/mortality rate
Nontunneled catheter: temporary bridge
Peritoneal dialysis catheter: permanent abdominal wall catheter; patient's own peritoneum is dialysis membrane

Complications of Renal Failure (EMS-Relevant)

Fluid overload:
Similar to CHF; may coexist with cardiomyopathy (uremic CMP or high-output from AV fistula)
Treatment: O2, nitrates, CPAP/BIPAP if needed
Avoid diuretics in anuric patients; higher doses needed in partial renal function
Hyperkalemia (Most feared acute complication):
Kidney excretes 95% of daily potassium intake
ESRD patients tolerate higher K+ than normal patients (but fatal arrhythmias can still occur)
ECG changes (poor sensitivity and specificity: do not rely on ECG alone):

ECG Finding	Significance
Peaked T-waves	Early
PR prolongation	Moderate
Wide/bizarre QRS	Severe
Conduction blocks	Severe
Sine wave	Pre-arrest
Bradycardia, VF, asystole	Terminal

Hyperkalemia Treatment Ladder
IV Calcium: stabilizes the cardiac membrane; does NOT lower K+
Calcium gluconate: 1,000 mg (10 mL of 10%) IV over 2-3 min
Calcium chloride: 500-1,000 mg (5-10 mL of 10%) IV over 2-3 min
Duration ~30-60 min; may repeat. **Flush line before giving bicarb** (calcium carbonate precipitates)
Sodium Bicarbonate: alkalinizes blood, shifts K+ intracellularly
Isotonic bicarb preferred; hypertonic 8.4% has neutral cellular effect
Reserved for pH <7.2 or when calcium is contraindicated (e.g., digoxin toxicity)
Dose: 50 mEq IV over 5 min; repeat q10-15 min
Albuterol: shifts K+ intracellularly; nebulized 10-20 mg in 4 mL NS over 10 min
Not immediate; rebound effect; risk of tachyarrhythmia
Definitive: Dialysis. All field treatments are temporizing. Communicate this clearly at handoff.
RSI and Hyperkalemia:
Avoid **succinylcholine** in renal failure patients (and stroke >72h, crush injury >72h, burns >72h, muscular dystrophy)

Succinylcholine → upregulated ACh receptors → massive K+ efflux → fatal arrhythmia
Use **rocuronium** instead
Pericarditis / Pericardial Tamponade:
Uremic pericarditis (pre-dialysis or within 8 weeks of starting) vs. dialysis-associated (after 8 weeks)
Classic ECG findings may be ABSENT in ESRD pericarditis
Tamponade: hypotension + dyspnea + distant heart sounds + JVD + pulsus paradoxus + electrical alternans
POCUS can help diagnose pericardial effusion in the field
Anemia: Hemoglobin <10 common in CKD (EPO deficiency)
Cardiovascular Disease:
LVH common: may obscure ischemic changes on ECG
Infection:
ESRD patients have impaired innate and adaptive immunity
Indwelling dialysis catheters = infection risk
Transplant patients on immunosuppression: afebrile, atypical presentations, opportunistic infections
Sepsis: do not withhold 30 mL/kg fluid bolus out of fear of pulmonary edema: evidence suggests safe in ESRD

Hemodialysis Complications

Hypotension: 10–50% of HD sessions; from fluid removal; treat with fluids
Air embolism: from dialysis circuit; position left lateral decubitus; 100% O2
Disequilibrium syndrome: rapid solute removal → cerebral edema; headache, N/V, AMS, seizures
Bleeding: uremia impairs platelet function; aggressive hemorrhage control
Peritoneal dialysis peritonitis: cloudy PD fluid, abdominal pain, fever

Peritoneal Dialysis Complications

Peritonitis: most common infectious complication; cloudy effluent
Hyperglycemia from dextrose-based dialysate

Disaster Preparedness

Include dialysis units in MCI/disaster planning: ESRD patients cannot skip sessions without life-threatening consequences

Destination

Choose hospitals with dialysis capabilities for ESRD patients when possible
Exam Trap:
Succinylcholine is contraindicated in renal failure. Use rocuronium. This is a classic wrong-answer choice.
ECG changes in hyperkalemia have poor sensitivity and specificity. Do not rely on the ECG alone to rule out dangerous hyperkalemia.
Classic ECG findings of pericarditis may be ABSENT in ESRD pericarditis. The inflammation does not involve the epicardium.
All field hyperkalemia treatments are temporizing. Only dialysis is definitive. Say this at handoff.
Dialysis access sites should NOT be used for IV access except in cardiac arrest.

PRIORITY PATCH

► Succinylcholine in renal failure = fatal hyperkalemia from K+ efflux. Use rocuronium instead.
► Calcium first for symptomatic hyperkalemia: stabilizes the membrane but does NOT lower K+. Flush before bicarb.
► HyperK ECG changes: peaked T-waves (early) → wide QRS → sine wave → arrest. Poor sensitivity; don't rely on ECG alone.
► ESRD pericarditis: classic ECG findings often absent. Consider tamponade in hypotensive ESRD patient with JVD.
► Sepsis in ESRD: give the 30 mL/kg fluid bolus. Evidence supports it as safe.

⚡PULSE CHECK

QUESTION 1

Which dialysis access type has the highest complication and mortality rate?

A. AV fistula
B. AV graft
C. Tunneled central venous catheter
D. Peritoneal dialysis catheter

Answer: C

Tunneled central venous catheters have the highest complication and mortality rate. AV fistula is the gold standard with the lowest complication rate. AV grafts are more prone to complications than fistulas.

QUESTION 2

Peaked T-waves on ECG in a dialysis patient represent which acute threat?

A. Fluid overload with pulmonary edema
B. Hyperkalemia with risk of cardiac dysrhythmia
C. Uremic pericarditis
D. Metabolic alkalosis

Answer: B

Peaked T-waves in a dialysis patient = hyperkalemia --- the most feared acute complication of renal failure. ECG progression: peaked T-waves → QRS widening → sine wave → cardiac arrest. Treatment: calcium, sodium bicarbonate, albuterol.

QUESTION 3

Compared to Caucasians, African Americans have what increased incidence of ESRD?

A. 1.5×
B. 2×
C. 3.4×
D. 5×

Answer: C

African Americans have a 3.4× higher incidence of ESRD compared to Caucasians, primarily driven by diabetes and hypertension. CKD is defined as GFR <60 mL/min for more than 3 months.

23 Infectious and Communicable Diseases

EMS Role

First healthcare workers to encounter communicable diseases in the community
>1.2 million community-based first responders at risk
SARS outbreaks (Toronto, Taipei 2003): EMS personnel infected in significant numbers; one paramedic fatality; established need for formal EMS infectious disease preparedness

Key Definitions

Infectious disease: invasion of host by disease-producing organism
Communicable disease: can be transmitted person-to-person
Example: Malaria is infectious but **NOT communicable**

Modes of Transmission

Mode	Description	Examples
Direct contact	Person-to-person (biting, kissing, sexual)	Herpes simplex
Indirect contact	Contaminated intermediate object	Staph via bedclothes
Droplet	Large droplets; short range	SARS, RSV, influenza, rhinovirus
Airborne	Small particles; suspended; travels distance	TB, varicella, measles
Vector	Arthropod-borne	West Nile, malaria, Lyme disease
Common vehicle	Single contaminated source → multiple hosts	E. coli, Salmonella outbreak

General EMS Approach

Risk assessment begins with the call taker
On-scene screening: fever/chills? cough/runny nose? diarrhea/vomiting? recent travel or contact with outbreak area?
Select appropriate PPE before patient contact
Transport to appropriate facility

Specific Diseases: High-Yield Summary

Influenza
Types: **A** (most severe, pandemics), **B** (milder, more pediatric), **C** (rare, no pandemics)
Transmission: droplet
Incubation: **1 day before symptoms** to 5 days after onset (contagious before symptomatic)
Symptoms: fever, sore throat, cough, myalgia, headache, chills
Prevention: annual vaccine (primary method), handwashing, antivirals as prophylaxis
Treatment: antivirals for immunocompromised; supportive for most

Avian Influenza
Type A influenza carried by wild birds; can kill domesticated poultry
H1N1 and H5N1 are deadly strains found in humans

Tuberculosis (TB)
Mycobacterium tuberculosis
Transmission: **airborne**
Incubation: 2–10 weeks
Symptoms: cough, hemoptysis, weight loss, night sweats, fever, fatigue
PPE: **N95 mask** (minimum)
Active TB treatment: **RIPE**: Rifampin, Isoniazid, Pyrazinamide, Ethambutol (4-drug regimen)
Infectious for ~2–4 weeks after starting therapy
Latent TB treatment: Isoniazid ×6–9 months
Post-exposure testing: initial test + repeat 8–12 weeks later
Notify public health

SARS / MERS / COVID-19 and Related Coronaviruses
Transmission: droplet

Symptoms: fever, headache, malaise, myalgia, diarrhea, vomiting, cough
During outbreak: consider limiting or avoiding aerosolizing procedures: **intubation, nebulization, deep suctioning, NIPPV**

Bioterrorism Agents: Category A (High-Yield)

Anthrax (Bacillus anthracis)
Three presentations:
Cutaneous: painless papule → painless black eschar with disproportionate edema; low mortality with antibiotics
GI: nonspecific → hemorrhage; mortality 25–60%
Inhalational: flu-like initially → fulminant; mortality 75% with antibiotics, 97% without
Transmission: injected, ingested, or inhaled from environment; **NOT person-to-person**
Post-exposure prophylaxis: **doxycycline or ciprofloxacin ×60 days**
Vaccine available

Botulism (Clostridium botulinum)
Neurotoxin blocks acetylcholine release → **descending flaccid paralysis**
Four types: foodborne, wound, intestinal (infant), inhalational
No person-to-person transmission
Treatment: **Heptavalent Botulinum Antitoxin** + supportive care; mechanical ventilation often needed
Bag any suspected clothing/items

Plague (Yersinia pestis)
Transmission: contact and vector (fleas); use **airborne precautions** for pulmonary form
Forms: bubonic (lymph node involvement: buboes), septicemic, pneumonic
Symptoms: fever, chills, headache, malaise, suppurative lymphadenopathy
Mortality: 50–90% untreated; 15% treated
Treatment/prophylaxis: **doxycycline or ciprofloxacin**
Prophylaxis: cipro or doxy ×7 days

Smallpox (Variola major / Variola minor)
Variola major: **30% mortality**; Flat/hemorrhagic forms: >90% mortality
Transmission: **airborne**; strict respiratory AND contact precautions
Modified smallpox can occur in previously vaccinated persons
PPE: N95 masks for suspected cases
Contaminated items: autoclave or bleach
No treatment; vaccine available (and provides protection if given early post-exposure)
Rash: centrifugal (face/extremities > trunk), all lesions at same stage

Tularemia (Francisella tularensis)
Forms: ulceroglandular (most common), glandular, oculoglandular, oropharyngeal, pneumonic, septic
Transmission: through skin, mucous membranes, lungs, GI tract
Flu-like symptoms, fever, cough
Decontaminate vehicles and equipment after contact

Viral Hemorrhagic Fevers (VHF)
Arenaviruses, Bunyaviruses, Flaviviruses, Filoviruses
Examples: **Ebola, Marburg, Hantavirus, Lassa, Machupo**
Initial transmission: vector-borne (varies by virus)
Person-to-person: direct contact with blood/fluids
Monitor exposed persons for 3–21 days with twice-daily temperatures
Treatment: supportive care; no approved specific therapies for most

Other Important Diseases

Chickenpox (Varicella Zoster)
Transmission: **airborne**
Incubation: ~10 days
Rash: "dew drops on a rose petal": starts on chest/back/face, spreads to extremities
Vaccine: 90–100% effective
Non-immune EMS workers: avoid patient contact days 10–21 post-exposure; vaccinate within 3–5 days of exposure
Non-immune + pregnant or immunocompromised: offer **VZIG within 96 hours** of exposure

Meningitis (Neisseria meningitidis)
Infectious from **1 week before symptoms** to **24 hours after treatment**

Post-exposure prophylaxis indicated only for close, unprotected contact:
Proximity <3 feet for >8 hours
PEP options:
Ceftriaxone 250 mg IM × 1
Ciprofloxacin 500 mg PO × 1
Rifampin 600 mg BID × 2 days
Exposed workers may return to work 24 hours after PEP started

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Key Numbers: *Meningitis PEP = <3 feet for >8 hours. Smallpox mortality: 30% (V. major), >90% (hemorrhagic). Anthrax inhalational = 97% mortality untreated.*

Exam Trap:
Malaria is infectious but NOT communicable person-to-person. A classic distinction on this topic.
Anthrax is NOT transmitted person-to-person. Plague (pneumonic form) requires airborne precautions despite normally being vector-borne.
Influenza is contagious one day BEFORE symptoms begin. Patients may not know they are infectious.
Meningitis PEP: only for close contact under 3 feet for more than 8 hours. Not every exposure requires prophylaxis.

PRIORITY PATCH

TB = airborne (N95 required). SARS/flu/RSV = droplet (surgical mask). Know the distinction.
Anthrax = NOT person-to-person. Plague = airborne precautions needed (despite usually vector-borne transmission). Botulism = descending flaccid paralysis.
— Rifampin, Isoniazid, Pyrazinamide, Ethambutol

⚡PULSE CHECK

QUESTION 1

Malaria is classified as:

A. Communicable but not infectious
B. Infectious but not communicable
C. Both infectious and communicable
D. Neither infectious nor communicable

Answer: B

Malaria is infectious (caused by a disease-producing organism) but NOT communicable (cannot be transmitted person-to-person). It requires a vector (Anopheles mosquito). Communicable diseases require person-to-person transmission.

QUESTION 2

Tuberculosis, measles, and varicella share which transmission method?

A. Droplet transmission
B. Airborne transmission
C. Direct contact transmission
D. Vector-borne transmission

Answer: B

TB, measles, and varicella are airborne --- small particles remain suspended and travel over distances. Droplet transmission (influenza, pertussis, meningococcus) requires close contact. This distinction drives different PPE requirements.

QUESTION 3

During the 2003 SARS outbreaks in Toronto and Taipei, which pattern emerged among EMS personnel?

A. EMS personnel were protected by existing PPE protocols
B. EMS personnel were infected in significant numbers with one paramedic fatality
C. EMS had lower infection rates than hospital staff
D. No EMS-specific SARS deaths occurred outside Asia

Answer: B

During 2003 SARS outbreaks in Toronto and Taipei, EMS personnel were infected in significant numbers with one paramedic death. This established the need for formal EMS infectious disease preparedness.

24 Choking

Epidemiology and Basics

Time-sensitive; can rapidly progress to cardiac arrest
Most obstructions occur in the **hypopharynx**
Food is most common object; non-food objects common in children
Highest risk groups:
Toddlers 1–4 years: non-food items
Ages 4–9 years: gum, candy
Adults >60 years: concurrent medical conditions (dysphagia, dental issues, neurologic)
Bystanders are often the first responders: community education in Heimlich is essential

Maneuvers and Effectiveness

Heimlich maneuver (abdominal thrusts):
~86.5% effective at removing obstruction in awake patients
Preferred for conscious adults and children >1 year
Chest thrusts (ACLS now recommends):
Preferred for: unconscious patients, pregnant patients, obese patients, infants <1 year
Higher morbidity than abdominal thrusts but often more feasible
Blind finger sweeps: **No longer recommended**

EMS Interventions (Escalating)

Heimlich maneuver
Direct visualization and removal with Magill forceps (after laryngoscopy)
Intubation to push foreign body into right mainstem bronchus (temporizing only)
Cricothyroidotomy: **last resort**
ENT consultation after initial stabilization

Key Rules

All choking patients should be transported: even if resolved, the foreign body may still be partially obstructing or have migrated distally
Visualize with laryngoscopy before any instrumentation; blind finger sweeps are no longer recommended
Exam Trap:
Blind finger sweeps are no longer recommended for unconscious choking patients. Visualize first.
For unconscious patients, ACLS now recommends standard CPR chest compressions, not abdominal thrusts.
Chest thrusts (not Heimlich) for: infants under 1 year, pregnant patients, obese patients.
Do not assume the airway is clear after a choking episode resolves on scene. Always transport.

PRIORITY PATCH

► Unconscious choking patient: CPR compressions (ACLS). Not abdominal thrusts. Not blind finger sweeps.
► Infants under 1 year: back blows + chest compressions. Not Heimlich.
► Pregnant/obese patients: chest thrusts.
► After apparent resolution: always transport. Partial obstruction or distal migration may still be present.

⚡PULSE CHECK

QUESTION 1

Which technique is no longer recommended for the unconscious choking patient?

A. Heimlich maneuver
B. Chest thrusts
C. Blind finger sweeps
D. Laryngoscopy with Magill forceps

Answer: C

Blind finger sweeps are no longer recommended for unconscious choking patients --- they can push the object deeper. Visualization with laryngoscopy and Magill forceps is appropriate after confirming the object's location.

QUESTION 2

Which age group has the highest risk of choking on non-food items?

A. Adults over 60
B. Toddlers aged 1--4 years
C. Adults aged 30--45
D. Adolescents aged 13--18

Answer: B

Toddlers 1--4 years are at highest risk for non-food item choking. Ages 4--9 more commonly choke on gum/candy. Adults over 60 have highest risk from concurrent medical conditions (dysphagia, dental issues, neurologic disease).

QUESTION 3

Why should all choking patients be transported even after apparent resolution?

A. All choking requires mandatory psychiatric evaluation
B. The foreign body may still partially obstruct or have migrated distally
C. EMS is legally required to transport all choking victims
D. To document the Heimlich maneuver in the medical record

Answer: B

Even after apparent resolution, the foreign body may be partially obstructing or have migrated distally. Distal migration causes progressive pulmonary complications that may not be immediately apparent.

25 Submersion Injuries and Drowning

Definitions (Current WHO/Wilderness Medicine)

Drowning: respiratory impairment from submersion/immersion in liquid
Outcomes: death, morbidity, no morbidity
Old terminology (near-drowning, dry drowning, secondary drowning) discouraged: use "drowning" with outcome descriptor
Secondary drowning: death from ARDS/pulmonary edema following a submersion event (still used clinically)

Epidemiology

~4,000–7,000 nonfatal drowning cases/year in the US; >half require hospitalization
~3,000–6,000 fatal cases/year
Up to **80% of drowning deaths are preventable**
10% of survivors have severe lasting neurologic effects (from cerebral hypoxia)
Drowning risk **3–4× higher** in unfenced vs. fenced pools
Children: most result from lapses in adult supervision; often "out of sight" for <5 minutes
Accomplished swimmers ≈35% of drowning deaths in those <20 years
Seizure history → 4× higher drowning risk

Pathophysiology

Classically: panic → breath-holding → involuntary aspiration → hypoxia → cardiac arrest
Cerebral hypoxia is the primary driver of morbidity
Hypothermia may be neuroprotective: cold water submersion can result in survival after lengthy immersion (do not assume death without full resuscitation in hypothermic drowning)

Dispatch Life Support

Immediately provide CPR instructions + AED instructions
42% of children drowning at home had no CPR until EMS arrived
Dispatchers should be cautious about directing bystanders to enter moving water: risk of secondary victims

Scene Safety and Extrication

Scene safety is paramount: especially in natural water and moving water
Rescuers NOT trained in water rescue should NOT enter moving water
Crowd control essential: bystanders can become secondary victims
Rapid extrication from water is priority
Airway interventions in the water are difficult: defer to land except for basic maneuvers
Do NOT perform maneuvers to drain water from lungs (outdated; not effective; causes delay)

Cardiac Arrest Drowning Management

Standard cardiac arrest algorithms: no modification needed
Begin CPR as soon as practical (some advocate while still in the water if safe)
BVM immediately on extrication
Anticipate vomiting in up to **86%** of drowning victims receiving CPR
Advanced airway after extrication
Hypothermic arrest:
Moderate hypothermia (30–34°C): increase interval between medication doses; active external rewarming
Severe hypothermia (<30°C): single defibrillation attempt; withhold medications until core temp >30°C
Core temp measurement in the field is difficult: use best available clinical information

Non-Cardiac Arrest Drowning Management

ABCs, hemodynamic stabilization, oxygenation
Monitor: SpO2, cardiac rhythm, ETCO2, vitals, neuro status
All non-arrest drowning patients should be transported and evaluated: even asymptomatic patients can deteriorate
Conditions can worsen rapidly: **strongly discourage refusal of transport**
Consider specialty centers (trauma, pediatric) for perfusing patients when feasible
Consider active rewarming if significant hypothermia

Hypothermia and Drowning

Historic aggressive rewarming being questioned

Target core temp 32–34°C post-ROSC if cardiac arrest from accidental hypothermia (similar to TTM guidance)
"No one is dead until warm and dead": but rescuer safety and practical limits apply

C-Spine Immobilization

Cervical spine injury is uncommon in drowning without significant mechanism (e.g., diving)
Benefits of c-spine immobilization must be weighed against delays to rescue efforts and rescuer safety

Grief and CISD

Drownings are sudden, unexpected events: often involve young, healthy individuals
Significant emotional impact on bystanders, family, and rescue personnel
Monitor rescue personnel for grief reactions; refer for appropriate support (CISD)

Key Numbers: *80% of drowning deaths are preventable. 42% of children drowned at home had no CPR until EMS. 86% of drowning CPR patients vomit. Unfenced pool = 3-4x risk.*

Exam Trap:
Do NOT perform maneuvers to drain water from the lungs. They are outdated, ineffective, and delay resuscitation.
Cervical spine immobilization is NOT routine for drowning. Reserve for patients with worrisome mechanism (diving, high-impact).
Even asymptomatic non-arrest drowning patients must be transported. Delayed pulmonary edema can be fatal. Refusal must be strongly discouraged.
Hypothermia may be neuroprotective in cold-water drowning. Do not presume death without full rewarming and resuscitation.

PRIORITY PATCH

All non-cardiac-arrest drowning patients should be transported even if asymptomatic: delayed pulmonary edema can be fatal. Refusal should be strongly discouraged.
Do NOT try to drain water from the lungs: not effective and wastes time.

⚡PULSE CHECK

QUESTION 1

Current WHO/Wilderness Medicine terminology defines 'near-drowning' as::

A. Near-drowning with morbidity
B. Drowning with outcome descriptor
C. Secondary drowning event
D. Dry drowning syndrome

Answer: B

Current terminology uses 'drowning' with an outcome descriptor (e.g., fatal drowning, drowning with morbidity, drowning without morbidity). Terms like 'near-drowning,' 'dry drowning,' and 'secondary drowning' are discouraged for research consistency.

QUESTION 2

Full resuscitation should be attempted in cold water submersion because:

A. Cold water prevents cardiac rhythm deterioration
B. Hypothermia may be neuroprotective, allowing survival after lengthy submersion
C. Cold water prevents aspiration during submersion
D. Cold water slows oxygen consumption indefinitely

Answer: B

'No one is dead until warm and dead' --- hypothermia may be neuroprotective in cold water submersion, and survival after lengthy immersion is documented. Continue resuscitation until patient is adequately rewarmed.

QUESTION 3

The most commonly identified contributing factor in pediatric drowning events is:

A. The child being unable to swim
B. Unfenced pool access
C. Lapse in adult supervision, often less than 5 minutes
D. The child being unsupervised at home

Answer: C

Most childhood drownings result from brief lapses in adult supervision --- often less than 5 minutes 'out of sight.' Unfenced pools increase risk 3--4×. Even accomplished swimmers account for ~35% of drowning deaths under age 20.

26 Trauma Systems of Care

Trauma System Organization
Trauma systems = organized approach to managing acute injury across the continuum: prevention → prehospital → hospital → rehabilitation
In the US, systems are organized primarily at the **state level** (some county-level exceptions, e.g., San Diego)
Most states use **American College of Surgeons Committee on Trauma (ACS-COT)** standards
Designation = state agency authorization for a hospital to represent itself as a trauma center
Verification = external inspection by a non-biased team confirming standards are met
State trauma offices are typically co-located with the Office of EMS

WHO Criteria for a Fully Developed Trauma System

Formal EMS oversight by a lead agency
Universal access number (911)
Legislative mechanisms to regulate EMS
Education and training standards for EMS clinicians
Licensing/renewal requirements in place
Trauma center verification/accreditation mechanism
Lead agency with authority to supervise all trauma care
QA/QI for both prehospital and facility-based care

Criteria for Ideal Statewide Trauma System (West, 1988)

Legal authority for designation
Formal designation process
ACS standards used
Non-biased (out-of-area) survey teams
Number of centers based on population/volume
Triage criteria allowing direct transport to trauma center
System performance monitoring
Full geographic coverage

Trauma Center Levels (ACS-COT)

Level	Key Requirements
I	Highest level; regional referral center; ≥1,200 trauma admissions/yr OR ≥240 admissions with ISS >15; full surgical specialist call panel; in-house OR staff; teaches ATLS; surgical residency program; ongoing injury research; full-time injury prevention coordinator
II	Complex cases; trauma surgeon available **within 15 minutes**; full on-call specialist panel (neurosurg, hand, CT surgery, vascular, OMFS, ophthalmology, cards, GI, ID, pulm, nephro, critical care, etc.)
III	Rapid assessment, resuscitation, emergency operative care, stabilization, then transfer; general surgeon **immediately available**; ortho, radiology, anesthesia on call; transfer agreements required
IV	Rural resuscitation point; stabilize and transfer; rounds out inclusive system for geographic coverage

Performance Improvement & Data
TQIP (Trauma Quality Improvement Project): voluntary, risk-adjusted, observed-to-expected ratio benchmarking across trauma centers
NTDB (National Trauma Data Bank): national repository for voluntary trauma registry data
NEMSIS ↔ NTDB linkage: allows analysis of prehospital interventions on trauma outcomes
Trauma registries: required at all verified trauma centers
Performance improvement = 3-phase public health model: **Assessment → Policy Development → Assurance** (continuous loop)

Emergency Response & Field Triage
Goal: "**Right patient → right place → right time**"
Field triage = decision-making algorithm for selecting patients who need trauma center transport

CDC assembled expert panels to revise field triage algorithm in **2006 and 2011**
Isolated mechanism criteria have very low sensitivity and PPV → risk of **overtriage**
Air vs. ground: ground transport is faster when trauma center is within **~10 miles** (helicopter setup/teardown time)
Interfacility transport: care level, distance, and urgency determine ground vs. air

Medical Oversight
Direct oversight (radio/phone/on-scene) was historically common; now mostly indirect (protocols/guidelines)
Direct oversight is almost always provided by **emergency physicians**, not trauma surgeons
EMS physicians must be integral participants in trauma system oversight
Audit filters for prehospital trauma care :
Lack of adequate airway / misplaced ETT
SpO_2 <90% on arrival
Inability to control external hemorrhage (no tourniquet applied)
Spinal immobilization in penetrating torso trauma
Scene time >10 min for critical patient
Failure to transport to closest appropriate facility

Public Health & Injury Prevention
Trauma is a **leading cause of death ages 1–44**
EMS systems/physicians should participate in community injury prevention (car seats, helmets, drunk driving, firearms storage, fall prevention for elderly)
Trauma is viewed as a **preventable disease** using a public health model
Exam Trap:
Designation vs. **verification**: designation is state authorization to call itself a trauma center; verification is independent external confirmation that standards are met. Not the same thing.
Direct medical oversight for trauma is almost always provided by emergency physicians, not trauma surgeons.
Ground transport is faster than helicopter when the trauma center is within about 10 miles. Helicopter advantage grows with distance.

PRIORITY PATCH

ACS-COT acceptable undertriage rate = **≤5%**; acceptable overtriage rate = **25-35%**. High undertriage = poorly functioning system. High overtriage = costly but safer.

⚡PULSE CHECK

QUESTION 1

What distinguishes 'designation' from 'verification' of a trauma center?

A. Designation is external; verification is internal
B. Designation is state agency authorization; verification is external inspection confirming standards
C. Designation requires annual re-inspection; verification is permanent
D. They are interchangeable terms

Answer: B

Designation = state agency authorization for a hospital to call itself a trauma center. Verification = external inspection by a non-biased (out-of-area) team confirming standards are met. Both are necessary components of a trauma system.

QUESTION 2

What is the minimum annual trauma admission volume required for a Level I trauma center?

A. 250/year
B. 600/year
C. 1,200/year
D. 2,400/year

Answer: C

Level I trauma centers require ≥1,200 trauma admissions/year. They are the highest level, serving as regional referral centers. Level I center care provides a 25% reduction in fatality risk vs. non-trauma centers.

QUESTION 3

U.S. trauma systems are primarily organized at which governmental level?

A. Federal (FEMA)
B. Regional (multi-county)
C. State
D. Local only

Answer: C

U.S. trauma systems are organized primarily at the state level, with some county-level exceptions (e.g., San Diego). State trauma offices are typically co-located with the Office of EMS. ACS-COT standards are most commonly used.

27 Blunt Trauma Considerations

Core Concepts for EMS Trauma Care
Consistent, organized assessment algorithm applicable to **any** trauma patient
Appropriate use of local resources and hospital destination policies
Correct application of SMR, splinting, fluid resuscitation, pain management
High-risk low-frequency procedures: know when/how to use cricothyrotomy, finger/needle thoracostomy
Scene safety: traffic, power lines, heavy machinery, unsafe structures
Scene time <10 minutes for critical/unstable trauma patients

Primary and Secondary Surveys
For **critical patients**: primary survey only on scene; everything else en route
Secondary survey (head-to-toe, detailed) may be deferred until trauma center arrival
Omission of secondary survey for critical patient = appropriate prioritization, NOT an error
Only 35.3% of patients in one study met the ≤10 minute scene time goal

Air Medical Transport
Civilian evidence for air transport benefit is mixed; high overtriage rates (up to 85% in some studies)
Early discharge rate for air transport patients ~35% → suggests poor field triage
15% relative risk reduction in mortality/disability minimum needed for cost-effectiveness
When appropriate trauma center is within **15–45 minutes**, rapid ground transport → better outcomes than helicopter for hemodynamically unstable patients
Trauma centers overall: **25% reduction in fatality risk** vs. non-trauma centers

Trauma Scoring Systems
Primarily used for **research**, not acute field care
Revised Trauma Score (RTS) = GCS + respiratory rate + systolic BP (each scored 0–4)
Revised Trauma Score (RTS) Scoring

RR (min)	SBP (mmHg)	GCS	RTS Points
10–29	>89	13–15	4
>29	76–89	9–12	3
6–9	50–75	6–8	2
1–5	1–49	4–5	1
0	0	3	0

Shock index (HR ÷ SBP) = better 48-hr mortality predictor than either vital sign alone
CDC field triage uses age **>55** as threshold for increased death risk

Special Populations

Pregnancy

Trauma is **leading cause of maternal mortality**
Most common mechanism: **motor vehicle collisions** → abruptio placentae is leading cause of fetal death
"What's best for mom is best for baby"
Predictors of fetal loss: higher ISS, lower GCS, AIS abdomen >3, vaginal bleeding, shock with base excess
>20 weeks gestation: left lateral decubitus (15–30°) or reverse Trendelenburg to avoid aortocaval compression
Fetal viability estimated at **>24–26 weeks** by history or fundal height above umbilicus → affects destination choice

Geriatrics

CDC triage: age **>55** = higher death risk from trauma
More likely to have intra-abdominal injury with concurrent head, leg, or chest trauma regardless of MVC speed
GCS unreliable for predicting severe injury in elderly
NEXUS criteria **insufficient** to exclude c-spine fractures in elderly blunt trauma
Falls from <3 feet can cause significant injury
Under-triage is significant in this population → use more conservative algorithms

Pediatrics

Unique injury patterns: Waddell's Triad, handlebar injury, nonaccidental trauma (NAT)
Larger head circumference, smaller airway, different c-spine anatomy vs. adults
Fluid resuscitation often **underestimated** → 20 mL/kg boluses

PRIORITY PATCH

ALS vs. BLS in blunt trauma: evidence does not demonstrate mortality benefit of ALS over BLS prehospital care. Long-held beliefs about IV fluids and ETI in the field have been challenged by the OPALS study.

⚡PULSE CHECK

QUESTION 1

What is the target scene time for critical or unstable trauma patients?

A. <5 minutes
B. <10 minutes
C. <15 minutes
D. <20 minutes

Answer: B

Scene time for critical/unstable trauma patients should be less than 10 minutes. Only 35.3% of patients met this goal in one study. Primary survey only on scene; secondary survey deferred en route or at the trauma center.

QUESTION 2

Civilian evidence for air medical transport in trauma shows which pattern?

A. Consistently superior outcomes vs. ground transport
B. High overtriage rates (up to 85%) and ~35% early discharge rates suggesting poor field triage
C. Air transport improves all patients transported beyond 15 miles
D. Helicopter reduces mortality by 40% when appropriately used

Answer: B

Civilian air transport evidence is mixed. Overtriage rates up to 85% and ~35% early discharge rates suggest poor field triage. When a trauma center is within 15--45 minutes, rapid ground transport may produce better outcomes for hemodynamically unstable patients.

QUESTION 3

Trauma scoring systems are primarily used for:

A. Acute field triage decisions
B. Medication dosing calculations
C. Research and epidemiological analysis
D. Determining trauma center designation level

Answer: C

Trauma scoring systems (Revised Trauma Score, ISS) are used for research and epidemiological analysis, not acute field care decisions. They allow standardized comparison of outcomes across systems.

28 Motor Vehicle Crashes

Epidemiology
MVCs: third leading cause of death for all Americans
One death every **16 minutes** in US
Nonoccupant fatalities (pedestrians, cyclists, motorcyclists) have increased from 14% → 20% of MVC deaths over past decade
Annual US economic/societal cost: **~$836 billion**

MVC Biomechanics — Four Collisions
Vehicle strikes object: vehicle deforms/crumple zones absorb energy
Occupant strikes vehicle interior or loads restraint system
Internal organs strike musculoskeletal structures
Loose objects/unrestrained occupants strike other passengers
G-force = acceleration/deceleration measured against gravity; human tolerance ~**30g** (healthy, nonelderly adult)
Force ↑ with speed squared; doubling stopping distance cuts force in half
Seatbelts, airbags, and crumple zones increase effective stopping distance

Safety Restraints
3-point seatbelts: ↓ fatal injury risk by **45%** and moderate-to-critical injury risk by **50%** in passenger cars; **60–65%** in light trucks
Airbags: spread force across large body area, prevent direct impact with vehicle interior
Without seatbelts: occupant hits interior with weaker body parts (upper abdomen, chest to steering wheel) at full vehicle speed

Crash Types and Injury Patterns

Crash Type	% Fatal Crashes	Most Common Serious Injuries (in order)
Frontal	56%	Lower extremities > pelvis > thorax > head > abdomen
Side impact	23%	Head > thorax > pelvis > abdomen
Rollover	30% (single vehicle fatalities)	Thorax > abdomen > head > spine > extremities
Rear	Least dangerous planar	—

Frontal Crashes
Since frontal airbags: head/facial injuries, aortic and cardiac injuries much less common
Rib fractures still common, especially elderly

Rollover Crashes
Arrested rollover (stopped by fixed object) = greater compartment intrusion and injury risk
Ejection and partial ejection much more likely → must search large area around vehicle
Roof intrusion >12 inches = high-risk indicator
30% of all single-vehicle fatalities

Unusual Crashes
Incompatibility: mass + stiffness + geometry mismatch (SUV vs. compact car) → injuries higher in body (head, chest)
Underride/override: particularly lethal for occupants
Partial ejection = road rash on any body part = transport to highest available care

EMS Assessment Priorities at MVC Scene
Unrestrained occupants
Ejected occupants (look for: complex open wounds, empty child safety seat, broken glass/windshield)
Intrusion into occupant space: **>12 inches at occupant seat** or **>18 inches** at any interior location = high injury risk

Unique MVC Hazards
EV/Hybrid Vehicles
High-voltage cables identified by **orange insulation**
Disconnect battery, remove key before extrication
Treat undeployed airbags as **explosive devices**: do not cut, strike, or place objects near modules

Advanced Automatic Crash Notification (AACN)

Crash calculated as ≥20% risk of ISS 15+ injury → flagged to PSAP

Uses: change in velocity, number of impacts, rollover, seatbelt use, vehicle type, direction of force

PRIORITY PATCH

Side-impact crashes are **more dangerous** than frontal despite being less frequent. Near-side occupant = highest risk. T-type (striking passenger compartment) > L-type.

⚡PULSE CHECK

QUESTION 1

Three-point seatbelts reduce fatal injury risk in passenger cars by approximately:

A. 20--25%
B. 35--40%
C. 45%
D. 65--70%

Answer: C

Three-point seatbelts reduce fatal injury risk by 45% and moderate-to-critical injury risk by 50% in passenger cars (60--65% in light trucks). Airbags spread force across a large body area. Without seatbelts, occupants strike interior structures at full vehicle velocity.

QUESTION 2

In frontal impact crashes (56% of fatal crashes), what is the order of most common serious injuries?

A. Head > thorax > pelvis > lower extremities
B. Lower extremities > pelvis > thorax > head
C. Thorax > abdomen > head > spine
D. Pelvis > thorax > abdomen > head

Answer: B

Frontal impact: lower extremities > pelvis > thorax > head (most common serious injuries in order). Side impact: head > thorax > pelvis > abdomen. Rollover: thorax > abdomen > head > spine > extremities.

QUESTION 3

What would be the change in biomechanical force when a stopping distance is doubled?

A. Force doubles
B. Force is halved
C. Force is reduced by one quarter
D. Force is unchanged

Answer: B

Doubling stopping distance halves the force experienced. Force increases with velocity squared. Seatbelts, airbags, and crumple zones all increase effective stopping distance, reducing force on occupants.

29 Penetrating Trauma

Epidemiology
Trauma = leading cause of death ages **1–34** in North America; surpassed only by cancer and CVD >35 yo
Trimodal distribution of trauma deaths:
50% within minutes (exsanguination, CNS injury): EMS cannot help
30% within first few hours: **EMS can make a difference**
20% days–weeks later (MOF, sepsis): ICU care
Up to **⅓ of all traumatic deaths** occur before hospital arrival
Prehospital traumatic CPA: survival **0–5%**

Physics
Kinetic energy = ½ mass × velocity² → doubling velocity = 4x energy; tripling = 9x energy
Conservation of energy: projectile that stays in body transfers **all** its KE to victim
Weapon energy classification:
Low energy: knives, hand-launched missiles
Medium energy: handguns (200–400 m/s)
High energy: rifles (600–1,000 m/s)

Ballistics
High-velocity projectile (>750 m/s) = **3 injury mechanisms**:
Direct: crushing/lacerating tissues in the bullet track
Pressure wave: moves faster than the bullet; damages solid organs, blood vessels, and bone; greater with faster or blunter projectiles
Cavitation: temporary cavity 30-40x the bullet diameter; lower pressure sucks in air and debris
Yaw/tumble: bullet wobbles off axis after hitting tissue → increased surface area → more energy transfer
Bullet caliber = diameter in mm or hundredths of an inch; larger = more damage (generally)
Shotguns: effective at close range only; pellets lose velocity rapidly

Spinal Motion Restriction
SMR has little/no role in isolated penetrating trauma
Systematic review: association with **increased mortality** in penetrating trauma with SMR
NAEMSP, ACEP, ACS-COT, EAST all recommend **against** routine SMR in penetrating trauma
C-collar NOT required for penetrating firearm injuries to the head
Consider SMR only if neurologic deficit apparent or high suspicion in obtunded patient: even then, rapid transport takes priority

Hemorrhage Control
Direct pressure: controls most external bleeding including arterial
Hemostatic dressings (kaolin-based preferred): for bleeding not controlled by pressure or as adjunct
Tourniquets: apply for extremity bleeding not controlled by pressure, traumatic amputations, or when continuous pressure cannot be maintained
Write **TK** and time on limb or forehead
If first tourniquet fails → apply second one proximally

Fluid Resuscitation — Permissive Hypotension
Permissive hypotensive resuscitation: fluid only if **SBP <70 mmHg** or absent radial pulse
Whole blood or RBC transfusion preferred over crystalloid
IV/IO in lower limbs **relatively contraindicated** if abdominal vascular injury suspected
Systematic review: significant reduction in mortality with permissive hypotension

TXA
NAEMSP, ACEP, ACS-COT: **"Insufficient evidence to support or refute prehospital TXA"**
CRASH-2: benefit if given within 3 hours (most benefit <1 hr); harm if given >3 hours
STAAMP trial: no 30-day mortality benefit in prehospital hemorrhagic shock
May have role in military applications or prolonged transport

Transport and Scene Time
"Platinum 10 minutes": goal to begin transport within **10 minutes** of arrival on scene
"Golden Hour": best survival when surgery begins within 1 hour of injury
"**Scoop and run**" preferred in penetrating trauma: IV access en route, not on scene

"Stay and play" = rarely indicated in penetrating trauma

Specific Injury Patterns

Penetrating Chest

Open PTX (sucking chest wound): **3-sided occlusive dressing**
Tension PTX: needle decompression (5th ICS anterior axillary line OR 2nd ICS midclavicular: not medial to nipple line)
Cardiac box: anterior chest bounded by clavicles (superiorly), midclavicular/nipple lines (laterally), xiphoid/costal margins (inferiorly): includes epigastric area
Pericardial tamponade: more common with stab wounds (60–80% of cardiac stab wounds); Beck's triad (hypotension, tachycardia, muffled heart sounds); treat with thoracotomy
ED thoracotomy within 15 min: up to **25% survival** for isolated penetrating thoracic trauma with signs of life

Penetrating Abdomen

High mortality due to lack of skeletal protection and highly vascular structures
Evisceration: cover with sterile saline-soaked dressings then occlusive covering
Penetrating wounds: cover to decrease infection, observe for ongoing bleeding

Penetrating Neck

Zone 1 = high mortality (above clavicles, below cricoid)
Occlusive dressing to prevent air embolism if minimal bleeding
Direct pressure for brisk bleeding: bilateral compression/circumferential dressings contraindicated (bilateral carotid compression → cerebral infarction)
Common carotid injuries: ~10% of penetrating neck trauma
IV access on **opposite** extremity from neck injury (avoid disrupting injured subclavian vessels)
Expanding hematoma → impending airway compromise → **early intubation**

Penetrating Extremity

Vascular + bony injuries most significant
Arterial: bright red, pulsatile; venous: dark, continuous flow
Tourniquet for uncontrolled extremity hemorrhage

Penetrating Head

No SMR/c-collar for isolated penetrating head injuries
Impaled objects: do NOT remove in field
Two-thirds of penetrating TBI patients die before hospital

Termination of Resuscitation — Penetrating Trauma
Withhold resuscitation if: injuries incompatible with life (decapitation, hemicorporectomy, rigor mortis, dependent lividity) OR patient is apneic + pulseless + no organized ECG activity on EMS arrival
Terminate resuscitation after CPR up to **15 minutes** without ROSC
Mandated reporting: most jurisdictions require police notification of all GSWs
PCR = legal document: document what is seen/heard, not interpretations
Exam Trap:
SMR in penetrating trauma is associated with **increased** mortality. NAEMSP, ACS-COT, ACEP, and EAST all recommend against routine SMR for penetrating trauma.
Permissive hypotension does NOT apply when TBI is also present. Hypotension doubles TBI mortality — these are conflicting goals with no clean answer.
IV access for penetrating abdominal trauma: use upper extremity if possible. Lower extremity lines may infuse directly into the injured vessel.
"Scoop and run" is the correct approach for penetrating trauma. IV access should be established en route, not on scene.

> **PRIORITY PATCH**
>
> **Mnemonic: High velocity injury = DPC: D**irect, **P**ressure wave, **C**avitation

⚡PULSE CHECK

QUESTION 1

Which mechanism explains tissue damage extending well beyond the bullet track in high-velocity wounds?

A. Direct crushing of tissues in the bullet path
B. Pressure wave moving faster than the bullet, damaging surrounding structures
C. Yaw and tumble of the projectile after impact
D. Permanent cavitation equal to bullet caliber

Answer: B

The pressure wave in high-velocity wounds (>750 m/s) moves faster than the bullet and damages solid organs, vessels, and bone beyond the direct track. The three mechanisms: direct crushing, pressure wave, and temporary cavitation (30--40× bullet diameter). Yaw/tumble also increases energy transfer.

QUESTION 2

Prehospital traumatic cardiac arrest survival is approximately:

A. 15--25%
B. 10--15%
C. 5--10%
D. 0--5%

Answer: D

Prehospital traumatic cardiac arrest survival is 0--5%. Up to 1/3 of traumatic deaths occur before hospital arrival. The trimodal distribution: 50% within minutes (irreversible) --- EMS cannot help this group.

QUESTION 3

Spinal motion restriction in isolated penetrating trauma:

A. Is required for all penetrating neck injuries
B. Has little to no role
C. Is required for all gunshot wounds to the torso
D. Should be applied with any paresthesias

Answer: B

SMR has little to no role in isolated penetrating trauma. The mechanism does not produce the same unstable spinal patterns as blunt trauma. SMR in penetrating trauma can delay transport and worsen outcomes.

30 Traumatic Brain Injury

Epidemiology
TBI = **⅓ of all traumatic deaths** in US
~2.87 million ED visits/hospitalizations/deaths from TBI annually
Leading causes: falls (~half of ED visits), direct head impact (17%), MVCs (13%)
Males > females in nearly all categories
Highest death rate: age **>75** (78.5/100,000); then 65–74 (24.7/100,000)

Primary vs. Secondary Injury
Primary injury: direct impact, acceleration/deceleration, or penetrating wound → bleeding, contusion, cell death; irreversible once it occurs
Secondary injury: hours to days later; edema, further cell death from hypoxia, hypotension, metabolic derangements; **preventable**
Single episode of **hypotension** (SBP <90) → **2x increase in mortality**
Hypotension + hypoxia together → 6x increase in mortality
CPP = MAP – ICP (difficult to measure prehospitally)

GCS and TBI Classification

Severity	GCS Score
Mild	14–15
Moderate	9–13
Severe	≤8

GCS decrease of ≥2 points prehospitally = significant neurologic deterioration → increased in-hospital mortality
9% of head-injured patients experience prehospital GCS deterioration
Intoxication can falsely lower GCS → **over-triage** these patients
Alcohol/drugs: 37–51% of adult TBI patients are intoxicated at time of injury

Pupils
Asymmetry = difference >1 mm
Fixed pupil = <1 mm response to light
Unilateral dilation + decreased reactivity = increased ICP / uncal herniation (ipsilateral CN III compression)
Bilateral dilation in trauma: mortality ~60%
Dilated/nonreactive pupils do NOT indicate brain death in lightning strike victims

Prehospital Management Priorities

Airway
Secure airway: GCS ≤8, unable to maintain airway, hypoxic despite O_2
Prehospital intubation controversial for TBI: evidence mixed; mortality can increase if done poorly
Pediatric TBI: ETI does NOT improve survival vs. BVM
Key: experience + continuous monitoring mandatory if intubating

Oxygenation
Maintain **SpO_2 ≥90%** (continuous pulse oximetry required)
Hypoxia (SpO_2 <90) = independent predictor of worse outcome

Ventilation
Target **$EtCO_2$ 35–40 mmHg** for intubated patients
Avoid routine hyperventilation → cerebral vasoconstriction → ↓ CBF → secondary ischemia
Inadvertent hyperventilation occurs in up to **70%** of cases
Therapeutic hyperventilation ($EtCO_2$ 30–35 mmHg): only for signs of **cerebral herniation**: dilated/unreactive pupils, asymmetric pupils, extensor posturing, GCS drop ≥2 points

Circulation
Maintain **SBP ≥90 mmHg** (adult)
Single episode of hypotension doubles mortality
Isotonic crystalloid for fluid resuscitation

Hypertonic saline: "option" for GCS <8; no proven benefit for isolated TBI without shock
Albumin: **worsens** TBI outcomes: do not use
Steroids: **increase mortality** in TBI: do not use
Check fingerstick glucose for altered mental status

Additional Treatments
Mannitol: widely used in hospital; insufficient evidence for prehospital use
Therapeutic hypothermia: inconclusive evidence for TBI; no RCTs supporting prehospital use
Seizures: treat promptly; no evidence for prophylactic prehospital treatment

Anticoagulants/Antiplatelets
Aspirin, clopidogrel, warfarin, DOACs (dabigatran, apixaban, rivaroxaban) all increase ICH risk
Inquire about "blood thinners" → high concern even for mild head injury
Transport to trauma center / CT-capable hospital with rapid neurosurgical access

Concussion (Mild TBI)
1.6–3.8 million sports-related concussions/year in US
Clinical diagnosis: may or may not involve LOC
Symptoms: headache, nausea, dizziness, fatigue, vision changes, irritability, confusion
WHO definition: GCS 13–15 at 30 min post-injury
Athlete removed from play immediately; no return to play same day
Transport to ED if: altered mental status, suspected c-spine injury, neurologic deficits, recurrent vomiting, retrograde amnesia, prolonged LOC

Transport Decisions
Moderate/severe TBI (GCS ≤13): directly to Level I or II trauma center with neurosurgical capability and ICP monitoring
Indirect transfer to Level I/II → **50% increase in mortality** for severe TBI
Mild TBI (GCS 14–15): may transport to other facilities per local protocols if no other injuries mandate trauma center
Pediatrics: pediatric trauma center if available; otherwise Level I/II adult center capable of treating children
Exam Trap:
Steroids increase mortality in TBI. Do not use. This is a classic wrong answer.
Albumin worsens TBI outcomes. Do not use for fluid resuscitation in isolated TBI.
Routine hyperventilation is harmful. Target EtCO2 35-40 mmHg. Therapeutic hyperventilation (EtCO2 30-35) is only for active herniation signs.
Dilated nonreactive pupils in a lightning strike victim do NOT indicate brain death. This is a well-known exam trap.
Indirect transfer to a Level I/II center for severe TBI increases mortality by 50%. Go direct when possible.

PRIORITY PATCH

Monroe-Kellie Doctrine: skull is a fixed space; increased ICP → herniation → brainstem compression → death. Brain autoregulation is disrupted in severe TBI.

⚡PULSE CHECK

QUESTION 1

A single episode of prehospital hypotension (SBP <90 mmHg) in TBI increases mortality by approximately:

A. 1.5×
B. 2×
C. 4×
D. 6×

Answer: B

A single episode of hypotension doubles TBI mortality. Combined hypotension AND hypoxia increases mortality 6×. Prevention of secondary injury (avoiding hypotension and hypoxia) is the primary prehospital TBI intervention.

QUESTION 2

Bilateral dilated, non-reactive pupils in TBI indicate:

A. Brain death; stop resuscitation
B. ~60% mortality but does NOT preclude survival or stop resuscitation
C. Confirmed uncal herniation from bilateral mass lesions
D. Hypothermia-related reversible finding

Answer: B

Bilateral dilated/nonreactive pupils are associated with approximately 60% mortality but do NOT indicate brain death in the prehospital setting and should not prompt stopping resuscitation. They are a grave prognostic sign, not a definitive endpoint.

QUESTION 3

Severe TBI is classified as GCS:

A. ≤13
B. 9--13
C. ≤8
D. ≤5

Answer: C

GCS ≤8 = severe TBI. GCS 9--13 = moderate. GCS 14--15 = mild. Prehospital GCS decrease of ≥2 points is associated with increased in-hospital mortality. Intoxication can falsely lower GCS --- over-triage these patients.

31 Electrical Injuries

Epidemiology & Age Distribution
Trimodal age distribution:
Toddlers: household outlets and cords (oral burns from biting cords)
Adolescents: outdoor risk-taking near high-voltage power lines
Adults: occupational exposure (miners, construction, utility workers)
Electrocution = 3rd leading cause of construction worker death
~1,000–1,500 electrical deaths/year in US; >60% in ages 15–40

Pathophysiology: Six Factors Determining Outcome
Voltage: high voltage = >1,000 V; greater morbidity, more surgical procedures, more complications
Type of current: DC (direct current) = single violent contraction, tends toward asystole; AC (alternating current, US standard 60 Hz/110V) = **3x more dangerous** than DC at same voltage; causes flexor tetany (grasping); tends toward VF
Amount of current: perception threshold 0.2-0.4 mA; **"let-go current" 6-9 mA** (flexor tetany prevents release); thoracic tetany/respiratory arrest 20-50 mA; **VF at 50-100 mA**
Resistance: skin (high), bone (very high, generates heat), nerve/vessels (low); wet skin approaches zero resistance
Pathway of current: determines tissues at risk; through thorax → arrhythmias; through brain → seizures/paralysis
Duration of contact: longer contact = more heat generated ($Q = I^2Rt$)

Scene Safety
Assume victim is still in contact with source
Personnel stay **10–30 feet** from downed power lines until utility company confirms off
Rubber gloves/boots do NOT protect unless **specifically designed** for that voltage AND recently tested: microscopic holes can concentrate thousands of volts
Downed lines may appear insulated but are not; may arc and whip
Safety perimeter: one full span between adjacent utility poles in all directions

Assessment & Management
Most common cause of death: arrhythmias and cardiac arrest
Prompt CPR: victims often young, no prior CVD → aggressive resuscitation warranted
Cannot predict outcome based on age and initial rhythm in electric shock cardiac arrest
ECG baseline in all patients; continuous cardiac monitoring if: abnormal ECG, history of unconsciousness, high-voltage injury
Most common ECG changes: **sinus tachycardia, nonspecific ST-T wave changes** (transient)
Arrhythmias typically present within **first few hours**
Standard BLS/ALS resuscitation protocols apply
After cardiac arrhythmias/respiratory arrest addressed: **treat as trauma patient**
Falls, being thrown, blast effect → significant blunt trauma
Fractures/dislocations from forceful muscle contractions
Consider c-spine stabilization
"Kissing burn": arc across two flexor surfaces (e.g., antecubital fossa) = often associated with extensive underlying damage
Fluid resuscitation: **20–40 mL/kg** in first hour for significant electrical injury (may exceed Parkland formula predictions due to internal burns)
Electrical burns to high-voltage: transport to trauma centers (may have significant internal damage from current flow not evident externally)

Lightning Injury
Unidirectional cloud-to-ground current from static charge (cold high-pressure over warm moist low-pressure)
>1,000,000 V, but brief duration → actual energy delivered may be less than typical high-voltage injury
70% of lightning strikes are non-fatal; **30% involve >1 patient**
~80–90 deaths/year in US

5 Mechanisms of Lightning Injury
Direct strike: open area; usually fatal
Splash injury: lightning strikes nearby object or person and splashes to victim
Contact injury: victim touching a struck object or person
Step voltage/ground current: lightning hits ground, travels up one leg and down the other (body offers less resistance than ground)
Blunt trauma: thrown by concussive shockwave; opisthotonic muscle contractions can cause fractures

Lightning-Specific Clinical Features

Most common cause of death: immediate **cardiorespiratory arrest**
Excellent resuscitation potential → reverse triage
Dilated/nonreactive pupils = **NOT** brain death in lightning victims
Severe burns uncommon due to brevity of exposure; aggressive IVF less important than in high-voltage electrical injury
Flashover effect: wet skin → current runs along body surface → superficial burns; less internal injury
Lichtenberg figures ("feathering burns"): pathognomonic for lightning; extravasation of RBCs along flashover lines; **not true burns**
Keraunoparalysis ("lightning paraplegia"): immediate paralysis of limbs with pallor, cool temp, absent pulses from catecholamine release → **resolves within hours** (do not confuse with permanent deficit)
Other: TM rupture, ARF (3–15% of major lightning strikes), neuro effects (LOC, confusion)

PRIORITY PATCH

Mnemonic: VTARPD: Voltage, **T**ype, **A**mount, **R**esistance, **P**athway, **D**uration
Lightning MCI = **REVERSE TRIAGE**: treat apparently dead patients first (unlike typical MCI)

⚡PULSE CHECK

QUESTION 1

Which type of electrical current is approximately 3x more dangerous than direct current at the same voltage?

A. DC --- tends toward VF
B. AC --- causes flexor tetany and grasping
C. High-frequency DC --- causes asystole
D. Pulsed AC --- causes immediate respiratory arrest

Answer: B

AC (60 Hz/110V, US standard) is approximately 3× more dangerous than DC at the same voltage. AC causes flexor tetany (grasping prevents release from the source). DC causes a single violent contraction and tends toward asystole.

QUESTION 2

EMS should remain how far from downed power lines until the utility company confirms de-energization?

A. 3--5 feet
B. 10--30 feet
C. 50--100 feet
D. 200 feet

Answer: B

Personnel stay 10--30 feet from downed power lines until confirmed de-energized. Rubber gloves/boots do NOT protect unless rated for that specific voltage. Always assume the victim is still in contact with the source.

QUESTION 3

Which tissue has the LOWEST electrical resistance making it most susceptible to injury?

A. Bone
B. Dry skin
C. Fat
D. Nerves and blood vessels

Answer: D

Nerves and blood vessels have the lowest electrical resistance, making them most susceptible to injury. Bone has very high resistance (generates heat). Dry skin has high resistance; wet skin approaches zero.

32 Blast Injury

Explosive Devices
IED (improvised explosive device): most common purposeful blast injury globally
UXO (unexploded ordnance): grenades, ammunition: significant cause of accidental injury
Average of **5 bombings per day** in US (1983–2002); 36,110 bombing incidents, ~700 deaths
Low-order explosives (gunpowder, Molotov): release energy slowly by **deflagration**
High-order explosives (dynamite, TNT, nitroglycerin): release energy almost instantaneously by **detonation** → generate blast wave

Blast Injury Categories

Category	Mechanism	Key Injuries
Primary	Blast wave (barotrauma); unique to explosions	Blast lung, TM rupture/middle ear damage, bowel perforation, globe rupture, concussion
Secondary	Shrapnel/debris acceleration; most common cause of trauma in survivors	Penetrating/ballistic wounds, eye penetration
Tertiary	Victim propelled by blast wind; blunt trauma	Fractures, traumatic amputation, impalement, TBI
Quaternary	All other explosion-related effects	Burns, crush injuries, exacerbation of existing conditions (asthma, COPD), inhalation injury
Quinary	Intentional addition of agents	Radiation, chemical, biological (e.g., suicide bomber with HBV/HIV)

Primary Blast Injury — Key Points
Injuries occur at **gas-tissue interfaces**: lung, sinuses, middle ear, bowel
Spall: tissue disruption from blast wave; small particles thrown into air space
Blast lung: most lethal primary injury; overpressure → bilateral pulmonary contusion/hemorrhage
Tympanic membrane rupture: most sensitive indicator of primary blast (lowest pressure threshold to rupture)
Patients with **blast lung are at risk for arterial gas embolism**: suspect if rapid deterioration after intubation
Location matters: indoor explosion → greater primary blast lung risk; in vehicles → increased thoracic/spinal injuries; open air → lowest mortality (8% vs. collapsed building 87%)

Prehospital Treatment
~70% of IED injuries involve extremities → immediate focus on tourniquets and limb hemorrhage control
Pelvic binder: consider in transfemoral amputations (40% have significant pelvic fractures)
Cervical spine: immobilize for blunt mechanisms when safe; high-velocity penetrating → no occult spinal injury → SMR not required if alert with no deficit
Head/neck injuries in 20–25% of IED blasts
Early antibiotic administration for open fractures
CPR in blast MCI: generally withheld unless cardiac arrest is immediately reversible (electrical injury, airway obstruction, tension PTX): treat reversible causes first
Balance: fluid restriction for blast lung vs. resuscitation for hemorrhage/burns

Medical Threat Assessment (MTA)
Consider potential medical threats that may confront responders during EMS operations
Develop a plan to mitigate and respond to those threats

Secondary Devices
Present in approximately 50% of terrorist attacks
First responders are primary targets of secondary devices
Designate a **"sweeper/spotter"** to search for secondary devices: starts at center of incident, moves outward in concentric circles
All patients should be searched for weapons/IEDs
Secondary devices may be programmed 1–12 hours after initial blast

Post-Exposure Management (Category 1 injuries — penetrating/nonintact skin)
Category 1 (penetrating/nonintact skin exposure): **intervene for HBV, consider testing for HCV, generally no action for HIV** (unless high-risk circumstances), **intervene for tetanus**
Ensure all responders have current tetanus and hepatitis B immunizations

PRIORITY PATCH

► See chapter content for high-yield points.

⚡PULSE CHECK

QUESTION 1

Which blast injury category is unique to explosions and involves barotrauma from the blast wave itself?

A. Secondary blast injury
B. Tertiary blast injury
C. Primary blast injury
D. Quaternary blast injury

Answer: C

Primary blast injury is unique to explosions --- caused by the pressure wave (barotrauma) at gas-tissue interfaces (lung, sinuses, middle ear, bowel). Secondary (shrapnel) is the most common cause of trauma in survivors. Tertiary: victim propelled by blast wind.

QUESTION 2

Blast lung is the most lethal primary blast injury and is caused by:

A. Shrapnel penetrating lung parenchyma
B. Victim thrown against hard surface causing pulmonary contusion
C. Overpressure from blast wave causing bilateral pulmonary contusion and hemorrhage
D. Inhalation of high-temperature gases causing airway burns

Answer: C

Blast lung results from primary blast injury: overpressure causes bilateral pulmonary contusion/hemorrhage. TM rupture is the most common primary blast injury. Spall = tissue disruption with small particles thrown into air spaces.

QUESTION 3

Intentional addition of biological or chemical agents to an explosive device is classified as which blast injury category?

A. Quaternary
B. Quinary
C. Secondary
D. Tertiary

Answer: B

Quinary blast injury = intentional addition of agents (radiation, chemical, biological). Quaternary = burns, crush, exacerbation of existing conditions, inhalation injury. These distinctions are testable.

33 Thermal and Chemical Burns

Epidemiology
212,820 reported acute burn admissions in US (2008–2017)
11,480 deaths from unintentional fires/burns in the US (2015–2018); 8,729 from residential fire/flame
Chemical burns: **3.4% of all burns**, **7% of burn admissions**
Cause breakdown: fire/flame 41%, scald 35%, contact 9.5%, chemical 3.4%, electrical 3.1%
74% of burns occur at home; 95% accidental
Risk factors: extremes of age, poverty, African or Native American descent, rural residents

Skin Anatomy (brief)
Epidermis: outer barrier layer; continuously shed keratinocytes; prevents fluid loss and foreign substance entry
Dermis: blood vessels, lymph vessels, hair follicles, sweat glands, fibroblasts, nerves; contains pain/touch receptors; collagen gives flexibility
Subcutis (hypodermis): collagen + fat; conserves heat, shock absorber

Burn Depth Classification

Degree	ABA Term	Appearance	Sensation	Healing	Scarring
1st	Superficial	Dry, red, blanches	Painful	3–6 days	None
2nd (superficial PT)	Superficial partial thickness	Blisters, moist red, blanches	Painful to air/temp	7–20 days	Unusual
2nd (deep PT)	Deep partial thickness	Blisters (easily unroofed), waxy, variable color, no blanch	Pressure only	>21 days	Severe
3rd	Full thickness	Waxy/leathery/charred, dry, no blanch	Deep pressure only	Never (if >2% TBSA)	Very severe
4th	—	Charred, exposed fat/muscle/tendon/bone	Insensate	Excision/amputation	N/A

Burn Size Assessment
Exclude first-degree (superficial) burns from TBSA calculation: only partial thickness and deeper counted
Rule of Nines (Adults): 9% each arm; 18% each leg; 9% head; 18% front torso; 18% back torso; 1% perineum
Rule of Nines (Children): 9% each arm; **14%** each leg; **18%** head; 18% front torso; 18% back torso (head larger, legs smaller proportionally vs. adults)
Palm of patient's hand (fingers closed) ≈ 1% TBSA; useful for small (<5%) or spotty burns
EMS tends to **overestimate** TBSA compared to burn surgeons

ABA Classification by TBSA

Type	Adult	Young/Old	Full Thickness	Disposition
Minor	<10% TBSA	<5% TBSA	<2%	Outpatient
Moderate	10–20%	5–10%	2–5%	Hospital admission
Major	>20%	>10%	>5%	**Burn center referral**

Burns Requiring Burn Center Referral (ABA Criteria)
Partial thickness burns >10% TBSA
Any full-thickness burn (any age)
Burns to face, hands, feet, genitalia, perineum, major joints
Electrical burns (including lightning)
Chemical burns
Inhalation injury
Burns with preexisting conditions complicating management
Burn + concomitant trauma (if burn injury = greatest risk)
Pediatric burns at hospitals without qualified personnel/equipment
Burns requiring special social/emotional/rehabilitative intervention

Inhalation Injury

Doubles mortality when combined with thermal injury
Decreases pulmonary compliance; increases fluid requirements
Edema of posterior pharynx/glottic/subglottic areas from deep burns to upper chest, neck, lower face
Tachypnea and stridor = late signs (unreliable for ruling out injury)
Consider CO and cyanide toxicity in confined space fires
High-flow O_2 for all respiratory distress; consider hydroxocobalamin for cyanide

Airway Management in Burns

ABA Indications for Intubation

Signs of obstruction: hoarseness, stridor, accessory muscle use, sternal retraction
TBSA burn >40–50%
Extensive/deep facial burns
Burns inside mouth
Significant edema or risk for edema
Difficulty swallowing
Respiratory compromise (cannot clear secretions, hypoxia, fatigue)
Decreased consciousness with impaired airway reflexes

Denver Criteria

Full-thickness facial burns
Stridor; respiratory distress
Swelling on laryngoscopy; upper airway trauma
Altered mentation; hypoxia/hypercarbia
Hemodynamic instability
Singed facial hair
Suspected smoke inhalation

Fluid Resuscitation

Clinically significant capillary leak in burns **>20% TBSA** (>10% TBSA in young/elderly)
Parkland Formula: LR 4 mL/kg/% TBSA (adults), 3 mL/kg/% TBSA (children) over 24 hours from burn time; 50% in first 8 hrs, 50% over next 16 hrs
Modified Brooke: LR 2 mL/kg/% TBSA (adults), 3 mL/kg/% TBSA (children) over 24 hrs (lower volumes)
Rule of 10 (prehospital simplification): estimate TBSA to nearest 10%; multiply by 10 = initial rate (mL/hr) for 40–80 kg patients; add 100 mL/hr per 10 kg >80 kg
Titrate to urine output: **0.5–1.0 mL/kg/hr** (adults), **1.0–1.5 mL/kg/hr** (children)
Avoid ice on burns: absolute contraindication (cold injury superimposed on burn)
Hypothermia increases burn mortality → keep patient warm, warm fluids
High-voltage electrical burns with myoglobinuria: use 4 mL/kg/% TBSA

Chemical Burns

pH <3 or >11 = caustic
Majority from **accidental workplace exposure**
Most common complications: cellulitis, pneumonia, respiratory failure
Common agents: hydrochloric acid, potassium hydroxide, sulfuric acid, phosphoric acid
Most fatalities from **ingestion**
Management: remove saturated clothing, brush off powders, copious water irrigation until pain decreases; no neutralizing solutions (except HF: see below)
Chemical eye injury: force eyelid open, flush with water/saline

Hydrofluoric Acid (HF)

HF >20% concentration → risk for serious burns and systemic toxicity
Dissociates into H^+ and fluoride ions; fluoride penetrates tissue deeply
May have latent period before burn apparent (concentration-dependent)
Primary metabolic derangement: **hypocalcemia** (also hyperkalemia/hypokalemia)
Treatment: Calcium (topical, then intradermal if needed; IV for systemic effects)
Topical: calcium gluconate 2.5% gel after copious water irrigation
Hands: calcium gluconate gel in surgical glove
IV: 10 mL of 10% calcium gluconate for large burns or documented hypocalcemia
Monitor QT interval
Nebulized 5% calcium gluconate for inhalational HF exposure

Compartment Syndrome / Escharotomy

Full-thickness circumferential burns can compress arteries/restrict chest expansion

Monitor for pallor, pulselessness, paresthesia, paralysis, pain out of proportion

Escharotomy incisions: medial and lateral portions of affected extremities; midaxillary lines of trunk connected by inverted V (chevron) along costal margins

Can be performed prehospital (with appropriate scope of practice) under local anesthesia or conscious sedation

Special Topics

White Phosphorus

Burns when exposed to air; very painful

Burned area must remain **wet/submerged** to prevent continued burning

Fluoresce under **Wood's lamp** in darkened room

Airbag Burns

Sodium azide ignition → rapid nitrogen expansion + sodium hydroxide

Can cause friction burns, chemical burns, cutaneous/ocular/inhalational injuries

Pain Management

Failure to manage pain → increased chronic pain and PTSD

Ketamine: early use associated with decreased PTSD

Advanced options for prolonged transport: ketamine, transmucosal analgesia, peripheral nerve blocks

PRIORITY PATCH

Adults: 4 mL × kg × % TBSA burn (LR)

Children: 3 mL × kg × % TBSA burn (LR + maintenance)

First half in **8 hours from burn time** (not arrival)

Second half over next 16 hours

Secure ETT with cotton umbilical ribbon: not tape: in burn patients. Edema causes skin to slough; tape will not hold and loss of airway in an edematous patient = disaster.

⚡PULSE CHECK

QUESTION 1

A blistered, moist red burn that blanches and is extremely painful to air describes which burn depth classification?

A. Superficial (first-degree)
B. Superficial partial-thickness (second-degree)
C. Deep partial-thickness (second-degree)
D. Full-thickness (third-degree)

Answer: B

Superficial partial-thickness (superficial 2nd degree): blisters, moist red, blanching, painful to air/temperature. Heals 7--20 days, usually without scarring. Deep partial-thickness: waxy, no blanch, pressure sensation only, heals >21 days with severe scarring.

QUESTION 2

What is the most common mechanism of acute burn admissions in the U.S.?

A. Scald burns
B. Fire/flame burns
C. Contact burns
D. Chemical burns

Answer: B

Fire/flame burns account for 41% of acute burn admissions, then scalds (35%), contact burns (9.5%), chemical (3.4%), electrical (3.1%). 74% of burns occur at home; 95% are accidental.

QUESTION 3

First-degree (superficial) burns are excluded from TBSA calculations because:

A. They involve only the epidermis and do not affect fluid resuscitation decisions
B. They are too painful to examine accurately in the field
C. They always heal without treatment
D. The rule of nines does not apply to them

Answer: A

First-degree burns involve only the epidermis (no blistering, no dermal involvement) and do not significantly affect fluid resuscitation calculations. Only partial and full-thickness burns are included in TBSA.

34 Crush Injury

Definitions
Crush injury: anatomical injury from direct trauma due to compressive force
Crush syndrome: systemic manifestation of skeletal muscle injury from **extended compression** → organ dysfunction (predominantly acute kidney injury) or death; first described by Minami (1923) after Messina earthquake (1908)
Traumatic rhabdomyolysis: release of cellular contents into vascular system from muscle breakdown
Compartment syndrome: increased fascial compartment pressure → compromises venous outflow → then arteriolar inflow → capillary leak + edema → progressive muscle damage → rhabdomyolysis

Pathophysiology
Mechanism: **ischemia/reperfusion injury** mediated by reactive oxygen species + activated neutrophils + intense local and systemic inflammatory response
Key factors: **mass of injured muscle** + **ischemia time**
Critical ischemia time for skeletal muscle: **4 hours** at body temperature (shorter with direct trauma vs. vascular occlusion)
Muscle compression → sarcolemma leak → release of **myoglobin, urate, potassium, phosphate**; influx of water, calcium, sodium into cells
After release of compression → reperfusion → systemic effects:
Hypovolemia/hypotension: massive fluid shifting into injured muscle
Hyperkalemia + metabolic acidosis: cardiac dysrhythmias, reduced CO
Acute renal failure: myoglobin + uric acid nephrotoxicity

Clinical Timeline
Traumatic rhabdomyolysis can occur in **<1 hour**
ARF following rhabdomyolysis: up to **33% of cases**; up to **50% of fatalities**
"**Smiling death**": patient appears well immediately post-extrication then sudden cardiovascular collapse from hypovolemia + hyperkalemia

Management of Crush Injury
Initial Approach (All Crush Injuries)
Primary survey; control life-threatening hemorrhage first
Dress and splint soft tissue/orthopedic injuries
Antibiotics for open injuries/fractures (especially with anticipated prolonged time to definitive care)
Pain management: opioids + adjunctive ketamine (0.1–0.2 mg/kg IV/IO); intranasal ketamine = effective alternative when IV access difficult

Compartment Syndrome
Classic signs are **late**: pulselessness, pallor, paresthesia, paralysis, pain out of proportion
Pain on **passive movement of distal digit** = earlier sign
In crush/disaster setting: fluid resuscitation + elevation (to heart level) preferred over **field fasciotomy** (risk of infection, nerve injury, no outcome data supporting field fasciotomy)

Management of Crush Syndrome (Suspected)
Fluid Resuscitation (Mainstay)
Adults: **1,000 mL/hr** for first 2 hrs, then **500 mL/hr**
Children: 15–20 mL/kg/hr then 10 mL/kg/hr
IV/IO access on **largely uninjured extremity**
Consider central venous access or hypodermoclysis if advanced provider available
Intermittent bolus infusions practical in rescue environment
Do NOT use tourniquets except for life-threatening hemorrhage (not for preventing crush syndrome reperfusion injury)

Hyperkalemia Treatment
Sodium bicarbonate (1 mEq/kg bolus q few hours): alkalinizes urine, protects kidneys; use 1 amp in 0.45% NS or 3 amps in D5W
Calcium (if ECG changes): note that calcium is taken up by injured muscle → difficult to raise serum levels; aggravates calcium-dependent apoptosis of myocytes: use cautiously
Albuterol (5 mg q few hours): effective for hyperkalemia; use compressed air if O_2 is limited resource in disaster
Glucose + regular insulin: effective but requires frequent glucose monitoring
ECG monitoring for hyperkalemia: T-wave changes → sine wave pattern (late) → but ECG lacks sensitivity/specificity for hyperkalemia

Nephroprotection

Mannitol (0.5 g/kg of 20% solution): osmotic agent + free radical scavenger; reduces compartment pressures + interstitial volume; reduces myoglobin/purine release; early use = nephroprotective

Transport

Designated trauma center even in absence of multisystem trauma

Trauma centers have access to plastic/reconstructive, microvascular, orthopedic surgery + critical care, nephrology, ID consults

PRIORITY PATCH

Crush syndrome leading to ARF = **2nd most common cause of morbidity in disasters** after direct trauma.

⚡PULSE CHECK

QUESTION 1

What is the critical ischemia time for skeletal muscle beyond which crush syndrome becomes likely?

A. 1 hour
B. 2 hours
C. 4 hours
D. 8 hours

Answer: C

Critical ischemia time for skeletal muscle is 4 hours at body temperature (shorter with direct trauma vs. vascular occlusion). Beyond this, rhabdomyolysis and systemic effects (hyperkalemia, acidosis, acute renal failure) are likely.

QUESTION 2

The primary purpose of aggressive IV fluid administration BEFORE crush extrication is:

A. To prevent hypothermia with warmed fluids
B. To dilute myoglobin and other released cellular contents before systemic circulation resumes
C. To correct metabolic acidosis before reperfusion
D. To reduce cardiac dysrhythmia risk by preventing hypovolemia

Answer: B

IV fluid (NS) given before extrication dilutes myoglobin and cellular contents before systemic reperfusion occurs. This helps prevent myoglobin-induced acute renal failure. Hyperkalemia and metabolic acidosis are also major concerns at reperfusion.

QUESTION 3

Acute renal failure follows traumatic rhabdomyolysis in approximately what percentage of cases?

A. 5--10%
B. 15--20%
C. Up to 33%
D. 50--70%

Answer: C

ARF follows traumatic rhabdomyolysis in up to 33% of cases. Up to 50% of crush syndrome fatalities have ARF as a contributing factor. Myoglobin and uric acid nephrotoxicity are the primary mechanisms.

35 Hemorrhage Control

Epidemiology
Uncontrolled hemorrhage = **~35% of trauma deaths** (second only to CNS injury)
Most deaths occur **before reaching definitive care** → prehospital hemorrhage control is critical
Military advances consistently translate to civilian improvements

Hemorrhage Recognition and Assessment
Arterial: bright red, pulsatile, spurts with heartbeat → requires pressure exceeding SBP to control
Venous: dark, continuous flow → amenable to hemostatic dressings; occludes at lower pressure
Capillary: brisk if platelet/clotting factor dysfunction; smaller vessels
Classic shock metrics (HR, BP, skin, urine, mental status) are limited:
Antihypertensives and other drugs blunt physiologic response
Healthy patients/children can maintain normal vitals despite significant blood loss

Alternative Shock Metrics

Metric	Calculation	Notes
Pulse pressure	SBP – DBP	Narrows before SBP drops; early indicator
Shock index	HR ÷ SBP	>1.0 = significant hemorrhagic shock; better predictor than either alone
Serum lactate (POC)	—	Emerging prehospital tool for hemorrhagic shock

"**Terrible Triad of Trauma**": **acidosis + hypothermia + coagulopathy** → each worsens the others

Treatment Modalities

Direct Pressure
Steady, firm pressure with gauze directly on bleeding site: most ancient, still primary method
Do NOT periodically check wound en route (disrupts clot → rebleeding)
Requires full attention of one clinician

Pressure Dressings
Elastic bandage/cravat over wound gauze
Pressure: not dressing material: is the key

Tourniquets
Apply if direct pressure fails for **extremity** bleeding
Safe and effective; adverse events <2%
Every US soldier carries one; near-universal acceptance in severe extremity bleeding/amputation
Write "TK" and time applied on patient's limb or forehead
If first tourniquet fails → apply **second tourniquet proximally**

Junctional Tourniquets
For **non-compressible areas**: groin, axilla, neck, junctional zones
FDA-approved devices (e.g., Combat Ready Clamp) available
Preliminary research shows effectiveness

REBOA (Resuscitative Endovascular Balloon Occlusion of Aorta)
Femoral artery → balloon inflated in thoracic or abdominal aorta → stops distal bleeding
Effective in-hospital and in surgical settings; prehospital feasibility demonstrated
Joint statement (ACS-COT, ACEP, NAEMSP): limited evidence; should only be placed by **trained physician** in conjunction with surgeon responsible for definitive hemorrhage control

Advanced Hemostatic Agents

Generation	Agent	Mechanism	Notes
1st	**Zeolite (QuikClot ACS+)**	Water absorption → concentrates platelets/factors	Exothermic reaction (concern); granular form replaced by gauze-based
2nd	**Kaolin (Combat Gauze)**	Activates intrinsic clotting pathway	**CoTCCC recommended agent**; low cost, strong safety profile, less heat
2nd	**Chitosan (Celox)**	Mucoadhesive; physically seals vessel; not coagulation-factor dependent	Powder form washes away; inferior to Combat Gauze in comparisons
3rd	**Celox-XG**	Chitosan-based nonwoven fabric	Easier to apply; similar efficacy to Combat Gauze; UK military standard

Adjunctive Therapies

Permissive Hypotension

Target **MAP 60–70 mmHg** (systolic ~80–90 mmHg)
Sufficient for vital organ perfusion without exacerbating bleeding (clot dislodgement, coagulation dilution)
Limits crystalloid exposure: crystalloids dilute clotting factors and trigger inflammatory cascades
Exception: concomitant TBI → hypotension increases TBI mortality → do NOT use permissive hypotension in TBI + hemorrhagic shock (conflicting goals; no established composite endpoint)

Hypothermia Prevention

Hypothermia <35°C = impairs coagulation enzyme activity
Hypothermia <30°C = **50% reduction in platelet function**
Remove wet clothing, warm blankets, increase ambient temperature, warm fluids

Blood Transfusion

Primarily for specialized teams and air medical providers (logistics of maintaining supply)
Whole blood/RBCs preferred over crystalloid for hemorrhagic shock
Massive transfusion protocol: platelets + plasma + packed cells in **1:1:1 ratio** → better hemostasis, lower transfusion volumes, improved survival
Fresh frozen plasma (FFP): 20 min thaw time, 5-day shelf life after thawing
Lyophilized (freeze-dried) plasma: up to 2-year shelf life; advantageous for MCI, long transports, austere environments
Fresh whole blood: all components; room temperature storage for ≤48 hours

TXA (Tranexamic Acid)

Antifibrinolytic: inhibits plasminogen activation → prevents clot breakdown
CRASH-2: small but significant mortality benefit when given within **3 hours** (most benefit <1 hr; harm if given >3 hrs)
STAAMP trial: no 30-day mortality benefit prehospitally for hemorrhagic shock
NAEMSP/ACEP/ACS-COT: "**insufficient evidence to support or refute prehospital TXA**"
May have role in military/prolonged transport situations

Recombinant Factor VIIa (NovoSeven)

Licensed for hemophiliacs with factor VIII antibodies; used off-label for trauma
Reduces pRBC transfusion need in blunt trauma; has NOT been shown to reduce mortality
Associated with ARDS; extremely expensive
Cochrane review: use only in FDA-approved indications or study protocol

PRIORITY PATCH

Combat Gauze is the CoTCCC recommended hemostatic dressing of choice for compressible hemorrhage not amenable to tourniquet.

⚡PULSE CHECK

QUESTION 1

Uncontrolled hemorrhage accounts for approximately what percentage of trauma deaths?

A. 10%
B. 20%
C. 35%
D. 50%

Answer: C

Uncontrolled hemorrhage accounts for approximately 35% of trauma deaths --- second only to CNS injury. Most occur before reaching definitive care, making prehospital hemorrhage control critical.

QUESTION 2

When applying direct pressure to a wound, providers should:

A. Periodically check the wound to assess clot formation
B. Apply steady, firm pressure without periodically releasing to inspect
C. Apply pressure in 2-minute cycles to allow reperfusion
D. Avoid pressure over suspected arterial bleeding

Answer: B

Steady, firm pressure without periodic checking is correct --- lifting the dressing disrupts clot formation and causes rebleeding. Direct pressure remains the primary and most ancient hemorrhage control method.

QUESTION 3

The 'Terrible Triad of Trauma' that worsens coagulopathy and increases mortality consists of:

A. Hypoxia, hypercarbia, and acidosis
B. Acidosis, hypothermia, and coagulopathy
C. Hypotension, tachycardia, and altered mental status
D. Hypoglycemia, hypothermia, and hemorrhage

Answer: B

The Terrible Triad: acidosis + hypothermia + coagulopathy. Each worsens the others in a vicious cycle. Hemorrhage control, warming, and damage control resuscitation all target this triad.

36 Orthopedic Injuries

General Approach

Primary survey first: only address orthopedic injury during primary survey if there is suspected hemodynamic compromise (actively bleeding wound or large-volume femur hemorrhage)
Obtain mechanism of injury: critical for identifying occult injuries
Hemorrhage control, pain management, and neurovascular preservation are the pillars of prehospital ortho care
Pain management: opioids remain standard; ketamine, NSAIDs, and acetaminophen have emerging prehospital roles
Document neurovascular exam **before and after** any manipulation, splinting, or patient movement

Neurovascular Examination

Upper Extremity

Upper Extremity Neurovascular Exam

Nerve	Motor	Sensory
Radial	Wrist/finger extension	First dorsal web space
Ulnar	Index finger abduction	Pinky finger
Median	Thumb/index opposition	Index finger
Axillary	Deltoid	Lateral shoulder
Musculocutaneous	Elbow flexion	Lateral forearm

Lower Extremity

Nerve	Motor	Sensory
Tibial	Toe flexion	Plantar foot
Sural	—	Posterolateral calf/foot
Superficial peroneal	Ankle eversion	Dorsal foot
Deep peroneal	Ankle dorsiflexion	First dorsal web space
Femoral	Knee extension	Anterior thigh/knee
Obturator	Hip adduction	Medial thigh

Upper Extremity Injuries

Bone/Joint	Key Points	Field Management
Clavicle	Check subclavian vessels, brachial plexus, pneumothorax; assess AC and SC joints	Sling and swathe
Scapula	Up to 75% have associated injuries (rib fx, pneumothorax, arm)	Sling and swathe
Shoulder (GH)	Most common major joint dislocation; usually anterior; axillary nerve/artery at risk; 15–35% associated fracture	Sling and swathe; short board if humeral head fracture suspected
Humerus	Axillary nerve/artery injury in up to 50% of displaced fractures; radial nerve at risk with midshaft	Sling and swathe, short board
Elbow	3rd most dislocated joint; 90% posterolateral from FOOSH; brachial artery + ulnar nerve at risk; supracondylar Fx common in peds	Short board splint
Forearm	Neurovascular compromise less common	Short board with sling
Wrist	Most common: distal radius/ulna, then scaphoid/triquetrum	Short board or pillow in position of function with sling
Hand/Fingers	High-pressure injection injury = always transport to ED	Buddy tape, malleable splint

Pelvis

Mortality 10–15%: venous hemorrhage into expanded pelvic vault
Highest hemodynamic instability: anterior-posterior compression mechanism
Suspect if: perineal/flank hematoma, blood at urethral meatus or vaginal introitus, obvious bony instability
Do NOT rock the pelvis to test for stability: can exacerbate fracture and bleeding
Pelvic binder (commercial or improvised sheet): reduces potential space, tamponades venous bleeding; reduces mortality

Lower Extremity Injuries

Bone/Joint	Key Points	Field Management
Hip fracture	80% in patients ≥75 y/o; 75% female; 90% from elderly falls; pain + shortening + external rotation	Backboard with pillows; no traction benefit (Cochrane 2011)
Hip dislocation	90% posterior (high-energy); 95% have other major injuries; reduce within 6 hours to prevent neurovascular complications	Prompt transport; splint in position of comfort
Femur	Large-volume hemorrhage possible; compartment syndrome rare; limb appears shortened	Traction splint
Knee	Popliteal artery at risk with dislocation; up to 50% spontaneously reduce prior to arrival; medial tibial plateau Fx → peroneal nerve + popliteal artery	Short board A-splint (bent); do NOT splint fully extended
Tibia/Fibula	Tibia = most commonly fractured long bone; 80% have concurrent fibula Fx; compartment syndrome in 8% tibial shaft Fx	Long board splint with slight flexion
Ankle/Foot	Ottawa rules: not validated prehospital: still transport for evaluation	Pillow splint

Spine Injuries

Cervical spine fracture incidence in trauma: ~4%; rises to 5–10% if trauma above clavicles
Overall spinal cord injury in blunt trauma: <2%
Neurogenic shock: hypotension + bradycardia (autonomic disruption)
Central cord syndrome (most common cord syndrome): bilateral weakness worst in distal upper extremities; common in elderly
Indications to Suspect Spinal Injury:
Multiple traumatic injuries
Focal neurologic deficits (weakness, numbness)
Neck or back pain / midline spine tenderness
Head injury + altered mental status or significant intoxication
Distracting painful injury in suspicious mechanism
Torticollis in children
SMR Terminology: "Spinal motion restriction" (SMR) is preferred over "spinal immobilization": true immobilization is not achievable

Splinting

Indications: Fracture, dislocation, sprain: reduces pain, prevents further injury, reduces hemorrhage, maintains alignment after reduction
Upper Extremity Splint Summary:
Splinting by Bone / Injury

Bone	Approach
Clavicle, scapula, shoulder	Sling and swathe
Humerus	Sling and swathe + short board
Elbow	Short board A-splint (bent) or straight
Forearm	Short board with sling
Wrist/hand	Short board or pillow in position of function with sling
Finger	Malleable splint or tongue depressor + buddy tape

Lower Extremity Splint Summary:

Bone	Approach
Hip	Backboard or long board splints, pillows
Femur	Traction splint
Knee	Short board A-splint (bent) or long board (straight)
Tibia/fibula	Long board splints
Ankle/foot	Pillow splint
Toe	Buddy taping

Traction Splints:
Standard for isolated femoral shaft fracture: reduces pain, limits blood loss and soft tissue injury
Application requires ~5–6 min with two trained providers
Complications: peroneal nerve palsy, compartment syndrome, urethral injury, pressure ulcers, distal ischemia
No evidence of benefit for hip fractures (Cochrane 2011)

Field Reductions

Not in national EMT/AEMT/paramedic scope: must be protocol-authorized
Generally defer if anticipated transport time is <30 minutes
Accepted indications for one attempt: distal neurovascular deficit or severe angulation
Risks of field reduction: converting dislocation → fracture-dislocation, causing further neurovascular compromise, converting closed → open fracture
After any reduction: splint immediately, reassess neuro/vascular, always transport
Common field reductions (no meds required):
Finger dislocations
Anterior shoulder dislocations (scapular massage, Stimson, FARES, Chair techniques)
Patellar dislocations: formal protocols exist with 92% success rates and dramatic pain reduction

Amputations

Control bleeding: direct pressure or tourniquet
Clean stump gently with sterile saline; cover with saline-moistened sterile gauze
Do not manually debride or clamp blood vessels
Splint underlying fracture (assume fracture); especially critical in partial amputations
Locate the amputated part: wrap in saline-moistened gauze → place in plastic bag → place bag on ice
Goal temperature: 4°C: do NOT freeze and do NOT immerse part directly in saline
Transport urgently to replantation-capable facility if available
If patient meets major trauma criteria and trauma center ≠ replantation center → trauma center takes priority

PRIORITY PATCH

Radial nerve = wrist drop. Axillary nerve = deltoid weakness + loss of lateral shoulder sensation (shoulder dislocation). Peroneal nerve = foot drop (knee/tibial plateau injuries).
Exam Pearl: Sternoclavicular: Posterior SC dislocations (from MVCs/sports) are MORE dangerous than anterior: risk of pneumothorax, great vessel injury, and tracheal injury. Both are treated with immobilization, but maintain high suspicion for intrathoracic injury with posterior dislocation.
Knee dislocation = popliteal artery injury until proven otherwise. Up to 50% spontaneously reduce before arrival: maintain high suspicion for vascular injury even with normal-appearing knee.
Field reductions are system/protocol-specific. An EMS physician can authorize and implement protocols that go beyond standard paramedic scope. If transport time is short, defer. If neurovascular deficit is present, one gentle attempt is reasonable.

⚡PULSE CHECK

QUESTION 1

The three pillars of prehospital orthopedic care are:

A. Splinting, analgesia, then neurovascular exam
B. Hemorrhage control, pain management, and neurovascular preservation
C. Reduction of dislocations, splinting, and analgesia
D. Analgesia first, then mechanism assessment

Answer: B

The three pillars: hemorrhage control, pain management, and neurovascular preservation. Document neurovascular exam before AND after any manipulation, splinting, or movement. Address orthopedic injury during primary survey only if hemodynamic compromise is suspected.

QUESTION 2

Weakness of ankle dorsiflexion and loss of sensation over the first dorsal web space localizes injury to:

A. Superficial peroneal nerve
B. Tibial nerve
C. Deep peroneal nerve
D. Sural nerve

Answer: C

Deep peroneal nerve: ankle dorsiflexion (motor) and first dorsal web space (sensory). Superficial peroneal: ankle eversion + dorsal foot. Tibial: toe flexion + plantar foot. Sural: posterolateral calf/foot (sensory only).

QUESTION 3

Which injury carries the highest risk of popliteal artery injury, potentially leading to limb loss?

A. Distal radius fracture
B. Clavicle fracture
C. Knee dislocation
D. Ankle fracture

Answer: C

Knee dislocation carries a 10--40% risk of popliteal artery injury and peroneal nerve injury. Immediate neurovascular documentation and urgent transport are essential. Missed popliteal artery injury can lead to limb loss.

37 Ocular Trauma

Epidemiology

2–3 million eye injury visits/year in the US
Highest risk: male sex, age under 30
Trauma = 2nd most common cause of monocular blindness (after cataracts)
Leading cause of ophthalmologic hospital admissions
>50% of patients with significant facial trauma have associated sight-threatening eye injuries
Do not let eye injuries distract from primary survey: facial swelling may compromise the airway

Initial Evaluation

Document visual acuity for each eye: Snellen chart, counting fingers, hand motion, light perception
Pinhole test corrects for refractive error if glasses unavailable
Assess: extraocular movements (especially superior gaze), pupil size/shape/reactivity, hyphema, proptosis, conjunctival hemorrhage, orbital rim crepitus
Test infraorbital nerve sensation (numbness = possible infraorbital nerve injury with orbital blowout)
Chemical exposure: irrigate immediately during assessment: do not delay

Specific Injuries

Chemical Burns (True Ophthalmic Emergency)

Irrigate immediately with tap water or NS: volume and duration matter more than the specific fluid
Alkali burns > acid burns in severity (household alkalis: sodium hydroxide, ammonia, calcium hydroxide)
Continue irrigation during transport for **minimum 30 minutes** for significant exposures
Obtain Safety Data Sheet from industrial exposures

Open Globe Injuries

Findings: decreased visual acuity, restricted EOMs, abnormal/absent pupillary reflex, teardrop pupil, vitreous extrusion, visible penetration
Once suspected: **stop further examination**
Management:
Hard eye shield (not pressure patch)
HOB 30–45 degrees
Pain control and anti-emetics (prevent increased IOP with vomiting)
Stabilize (do not remove) any penetrating foreign body
Transport to facility with ophthalmology

Traumatic Hyphema

Blood in anterior chamber; graded 1–4 based on filling percentage
Grade 3–4: higher risk of complications (rebleeding, corneal staining, increased IOP, optic nerve damage)
High risk with sickle cell disease, hemophilia, bleeding disorders
Management: HOB 30–45 degrees, protective eye shield, pain control, prompt transport

Corneal Injuries

Abrasions often invisible without fluorescein/slit lamp
Foreign body: flush with saline or remove if superficial; if penetrating globe suspected: shield and transport
High-risk activities: power tools, grinding, hammering without eye protection

Retinal Injuries

Less common; higher blindness risk
Symptoms: "flashing lights," "floaters," decreased visual acuity
Requires dilated fundoscopic exam: beyond prehospital scope
Transport for ophthalmologic evaluation

PRIORITY PATCH

► Open globe: hard eye shield (NOT a pressure patch). Pressure on an open globe can extrude vitreous.
► Chemical eye injury: irrigate immediately. Don't wait for full assessment. Volume and duration matter more than the specific fluid used.
► Alkali burns are worse than acid burns to the eye. Alkalis penetrate deeper and cause ongoing damage.
► Over 50% of patients with significant facial trauma have associated sight-threatening eye injuries. Don't let the face distract from the airway.

⚡PULSE CHECK

QUESTION 1

A patient has alkali splash to both eyes at a chemical plant. What is the most critical first action?

A. Call Poison Control for specific antidote
B. Irrigate immediately --- volume and duration matter more than the specific fluid
C. Patch both eyes and transport without irrigation
D. Apply topical anesthetic before irrigation

Answer: B

Chemical eye injury is a true ophthalmic emergency --- irrigate immediately, do not delay for any reason. Volume and duration matter more than fluid type. Alkali burns are more severe than acid burns (deeper penetration). Minimum 30 minutes for significant exposures.

QUESTION 2

A teardrop-shaped pupil after orbital trauma suggests:

A. Cranial nerve III palsy from elevated ICP
B. Open globe injury with vitreous extrusion
C. Traumatic iritis
D. Retinal detachment

Answer: B

Teardrop pupil (irregular, pointing toward a wound) indicates open globe injury, along with decreased visual acuity, restricted EOMs, and possible vitreous extrusion. Cover with a rigid shield --- NOT a pressure patch.

QUESTION 3

What percentage of patients with significant facial trauma have associated sight-threatening eye injuries?

A. 10--20%
B. 30--40%
C. >50%
D. 80--90%

Answer: C

>50% of patients with significant facial trauma have associated sight-threatening eye injuries. Do not let eye injuries distract from the primary survey --- facial swelling may compromise the airway first.

38 Bites, Stings, and Envenomations

Scene Safety First

Co-dispatch law enforcement and/or animal control as needed
EMS providers are NOT responsible for containing or capturing the animal
Do not transport live or dead animals to the hospital
Mandatory medical oversight contact for any refusal of care in animal bite situations: initial appearance often misleadingly benign

Animal Bites

General Principles:
1% of all ED visits; actual incidence underreported
Copiously irrigate all bites after hemorrhage control
Splint involved extremities
Most require transport for tetanus, wound evaluation, rabies assessment, and possible antibiotics
Mammalian Bites:
Dogs and cats = 93–96% of mammalian bites; mostly involve upper extremity
Dog/cat bites have significant infection risk; >30% of infected hand bites require surgery
Human bites: "fight bites" (MCP joint over extensor tendon) → >30% become infected
Rabies Post-Exposure Prophylaxis (PEP):
Universal PEP for bites from: **skunks, foxes, raccoons, bats** (even if no visible bite in sleeping person or child)
Dogs, cats, ferrets that appear healthy: quarantine 10 days before deciding on PEP
All potential victims should transport to ED for formal PEP assessment

Snake Envenomations

Feature	Crotalid (Pit Vipers)	Elapid (Coral Snake)
Species	Rattlesnakes, copperheads, cottonmouths	Coral snake
Venom type	Primarily hemotoxic (+ cytotoxic, neurotoxic)	Neurotoxic
Onset	Minutes to hours	Up to 12 hours: then rapidly progresses
Symptoms	Swelling, ecchymosis, coagulopathy, shock	Paresthesias → progressive paralysis, respiratory failure
Compression immobilization	**Contraindicated**	May be considered if long transport time
Analgesia	IV **fentanyl** (avoid morphine: histamine release mimics envenomation)	Supportive + airway readiness

"Dry bites" occur: absence of swelling does not rule out envenomation
All suspected snakebites should transport to ED for observation
Antivenin (CroFab® or Anavip®): not routinely administered prehospital
Dispel myths: incision, suction, cold therapy, electricity: all harmful and unsupported

Spider Envenomations

Spider	Mechanism	Presentation	Treatment
Black widow	ACh release (calcium channel-mediated)	Painful muscle spasm, diaphoresis, hypertension; rigid abdomen	Opioids + benzodiazepines; transport for possible antivenin
Brown recluse	Dermonecrotic toxin	Evolving necrotic wound; systemic loxoscelism (fever, rhabdo, hemolysis, DIC, renal failure)	Supportive: IVF, antiemetics; transport
Hobo spider	Dermonecrotic	Similar to brown recluse + headache, weakness, vision changes	Supportive

Hymenoptera (Bees, Wasps, Ants)

3 families: Apidae (honeybees/bumblebees), Vespidae (yellow jackets, hornets, wasps), Formicidae (fire ants)
~1% children and 3% adults have severe systemic reactions; prior exposure NOT required for anaphylaxis
Cross-reactivity within Hymenoptera families is common
Fire ant: circular sting pattern → sterile pustules; anaphylaxis in up to 6%

"Killer bees" (Africanized) = same venom as honeybee but mass attacks increase risk
Treatment: antihistamines, albuterol, epinephrine IM (1:1000, 0.3 mg if hemodynamically stable) → IV epi (1:10,000, 1 mg) if unstable

Scorpions

Bark scorpion (*Centruroides exilicauda*): only US species of toxicologic significance
Venom: neurotoxin opening sodium channels → catecholamine and ACh release
Children especially at risk for severe systemic neurotoxic symptoms
Treatment: opioids and benzodiazepines for symptoms; antivenom available for severe systemic cases

Marine Envenomations

Vertebrates (stonefish, lionfish, stingrays): heat-labile toxins → immerse in **hot water** for pain relief
Jellyfish/nematocysts: remove tentacles with gloved hands/forceps; hot water or topical lidocaine for pain; **vinegar** may work for bluebottle jellyfish; avoid urine, sand, meat tenderizer
Do NOT remove embedded sea urchin spines or stingray barbs (spines fracture; may require surgical debridement)

Ticks

Vectors for: Rocky Mountain spotted fever, Lyme disease, tularemia, ehrlichiosis, babesiosis, Colorado tick fever
Tick paralysis: Lone Star tick, American dog tick, Rocky Mountain wood tick → ascending motor paralysis (like botulinum)
Cure for tick paralysis = **remove the tick**; supportive airway management for ascending paralysis

Transport Considerations

Prefer facility with toxicology consultant or access to poison control
Use air transport per local protocol for severe envenomations requiring unavailable antivenom
Poison control and zoos are best resources for non-indigenous animal/insect exposures

PRIORITY PATCH

Exam Pearl: Bats: PEP is indicated for anyone who was sleeping in the same room as a bat and a bite cannot be ruled out, even without a visible wound.
Elapid envenomation can look deceptively benign for up to 12 hours before rapid neurologic deterioration. Transport ALL suspected snake bites regardless of initial appearance.

⚡PULSE CHECK

QUESTION 1

Which animal bite situation always warrants rabies PEP consideration, even without a visible bite wound?

A. Domestic dog appearing healthy
B. Bat --- including found in a room with a sleeping person
C. Squirrel in an endemic area
D. Domestic rabbit

Answer: B

Bats always warrant PEP consideration --- even without a visible bite, including when found in a room with a sleeping person or child. Raccoons, skunks, foxes, and coyotes also require universal PEP. Dogs/cats are quarantined 10 days before PEP decision.

QUESTION 2

What distinguishes coral snake envenomation from pit viper (crotalid) envenomation?

A. Coral snake venom is primarily hemotoxic with rapid local swelling
B. Coral snake venom is primarily neurotoxic with onset up to 12 hours then rapid progression
C. Coral snake causes immediate severe local pain and edema
D. Coral snake envenomation rarely requires antivenom

Answer: B

Coral snake (elapid): primarily neurotoxic, symptom onset delayed up to 12 hours, then rapid progression. Crotalids (rattlesnakes, copperheads, cottonmouths): primarily hemotoxic with immediate local swelling, pain, and tissue damage. Delayed onset is the key exam distinction.

QUESTION 3

Which statement is correct regarding animal bites and animal transfer?

A. Transport live animals for identification purposes
B. Transport dead animals for rabies testing
C. Do NOT transport live or dead animals to the hospital
D. EMS should capture animals for law enforcement

Answer: C

EMS should NOT transport live or dead animals. Law enforcement and animal control are co-dispatched. Mandatory medical oversight contact for any refusal of animal bite care --- initial appearance can be misleadingly benign.

39 Field Trauma Triage

Background

Unintentional injury = leading cause of death in persons aged 1–44 years
~25% reduction in mortality for severely injured adults treated at Level I vs. non-trauma centers
ACS-COT has published field triage guidance since 1976; CDC formalized the 4-step scheme
Current guidelines published 2012 (last major revision); revision process ongoing
Accuracy measures:
Over-triage: sending low-acuity patients to trauma centers (acceptable rate ≤50%)
Under-triage: missing patients who need trauma center care (**target <5%**)

The 4-Step Field Triage Decision Scheme

Step 1: Physiologic Criteria
→ *If abnormal: transport to HIGHEST level trauma center in defined system*
Field Triage Step 1: Physiologic Criteria

Measure	Threshold
GCS	≤13
Systolic BP	<90 mmHg
Respiratory rate	<10 or >29 breaths/min (<20 in infant <1 year) OR need for ventilatory support

Sensitive but not highly specific; PPV ~40% for ISS >15
GCS ≤13: OR 17.4 for death

Step 2: Anatomic Criteria
→ *Transport to highest level trauma center in defined system*
All penetrating injuries to head, neck, torso, extremities **proximal to elbow or knee**
Chest wall instability or deformity (flail chest)
Two or more proximal long-bone fractures
Crushed, degloved, mangled, or pulseless extremity
Amputation proximal to wrist or ankle
Pelvic fractures
Open or depressed skull fracture
Paralysis

Step 3: Mechanism of Injury Criteria
→ *Transport to trauma center (not necessarily highest level)*
Falls:
Adults: >20 feet (1 story = 10 feet)
Children: >10 feet or 2–3× height of child
High-risk auto crash:
Intrusion: >12 inches occupant side; >18 inches any site
Ejection (partial or complete)
Death in same passenger compartment
Vehicle telemetry consistent with high-risk injury
Auto vs. pedestrian/bicyclist thrown, run over, or with significant impact (>20 mph)
Motorcycle crash >20 mph

Step 4: Special Considerations
→ *Transport to trauma center or hospital with timely evaluation capability*
Field Triage Step 4: Special Considerations

Population	Consideration
Older adults (>55 y/o)	Risk increases with age; SBP <110 may = shock after age 65; ground-level falls can be severe
Children	Preferentially to pediatric-capable trauma centers
Anticoagulants/bleeding disorders	Head injury = high risk for rapid deterioration
Burns	Without trauma: burn center; with trauma: trauma center
Pregnancy ≥20 weeks	Higher risk for occult injury
EMS provider judgment	Independent predictor of severe injury (OR 1.23 for ISS >16)

Special Populations

Pediatrics:

2011 guidelines: sensitivity 84–87% for identifying children needing specialized care

MOI criteria in children have higher under-triage than in adults (77% under-triage rate in one study using MOI alone for children ≤15)

Availability of pediatric ICU (not just pediatric trauma designation) is what matters most for outcomes

Younger children (≤5): higher mortality at adult trauma centers; older children/adolescents: less difference

Older Adults:

46% of Medicare-aged trauma patients with ISS ≥16 are under-triaged

Under-triage increases with age, distance to trauma center, and rural location

Consider: SBP ≤110 or ≥200, HR ≤60 or ≥110, RR ≤10 or ≥24 as geriatric-specific vital sign thresholds

PRIORITY PATCH

Physiologic criteria alone have sensitivity ~0.7. Combining steps 1+2 raises sensitivity to ~0.8 with PPV ~27%. All 4 steps are needed to maximize sensitivity while limiting over-triage.

Steering wheel deformation has highest PPV (~26%) among MOI criteria. Ejection PPV ~10%. MOI alone identified an additional 25% of seriously injured patients not captured by steps 1–2.

⚡PULSE CHECK

QUESTION 1

Acceptable over-triage and target under-triage rates in the CDC Field Triage Decision Scheme are:

A. Over-triage ≤25%; under-triage <10%
B. Over-triage ≤50%; under-triage <5%
C. Over-triage ≤75%; under-triage <15%
D. Over-triage ≤10%; under-triage <1%

Answer: B

Acceptable over-triage: ≤50%. Target under-triage: <5%. Under-triage is more dangerous --- missing critically injured patients who need trauma center care can be fatal. Over-triage (sending low-acuity patients) wastes resources but is less immediately dangerous.

QUESTION 2

Step 1 (physiologic criteria) respiratory rate thresholds for adults are:

A. <12 or >24 breaths/min
B. <10 or >29 breaths/min
C. <8 or >30 breaths/min
D. <16 or >35 breaths/min

Answer: B

Step 1 physiologic criteria: GCS ≤13, SBP <90 mmHg, or RR <10 or >29 breaths/min (<20 in infants <1 year), or need for ventilatory support. GCS ≤13 carries OR 17.4 for death.

QUESTION 3

For adults, a fall from greater than what height triggers Step 3 mechanism criteria?

A. >10 feet
B. >15 feet
C. >20 feet
D. >30 feet

Answer: C

Falls >20 feet (1 story = 10 feet) in adults trigger Step 3 mechanism criteria. For children: >10 feet. Step 3 does NOT necessarily require the highest-level trauma center (unlike Steps 1 and 2).

40 Trauma-Stabilizing Procedures

Needle Thoracostomy

Indication: Suspected tension pneumothorax
Classic signs (tracheal deviation, absent breath sounds) may be absent or undetectable in prehospital environment
Consider in any blunt chest trauma patient with precipitous decline, especially with COPD/asthma history
Obvious subcutaneous emphysema also a trigger
Technique:
Identify 2nd intercostal space, midclavicular line (or alternatively: 4th–5th ICS, midaxillary line)
Sterile prep
Needle inserted perpendicular to skin, **over the superior surface of the inferior rib** (avoids neurovascular bundle)
Advance until air or blood returns
Advance plastic catheter into chest; remove needle
If spontaneously breathing: one-way valve required (Heimlich valve, commercial device, or condom on catheter)
If intubated: can leave catheter open to air
Complications:
Subclavian vessels (if needle placed too high at 2nd ICS)
Abdominal viscera (if needle too caudal with lateral approach)
Internal mammary artery laceration
Many standard needles are **too short** for obese patients: consider alternative site or longer needle if no clinical improvement
Catheter can migrate out of pleural space; reaccumulation is possible

Tube and Finger Thoracostomy

Indications:
Same as needle thoracostomy (finger thoracostomy confirms successful pleural entry)
Tube thoracostomy: rapidly evacuate large hemo/pneumothorax; especially useful with long transport times
Advantage over needle: lower risk of kinking, clotting, or dislodgement
Primarily used by air medical services and in military settings
Tube Thoracostomy Technique:
Abduct and externally rotate arm on affected side
Locate **5th intercostal space, midaxillary line** (no lower: risk of abdominal organ injury)
Sterile prep and local anesthetic
3–4 cm transverse incision over 5th or 6th rib at midaxillary line
Bluntly dissect with Kelly clamp **over top of rib** into intercostal space
"Definitive pop" upon entering pleural space: rush of air/blood
Spread Kelly, turn 90°, spread again; insert finger to verify position
Insert chest tube posteriorly and superiorly; verify all fenestrations inside chest
Secure with silk suture; petroleum gauze around tube; connect to drainage or Heimlich valve
Complications:
Empyema (difficult to maintain sterility prehospital)
Injury to heart, great vessels, abdominal organs (if placed too caudal)
Lung parenchyma injury from trocar/Kelly clamp

Pericardiocentesis

Indication: Hypotension or cardiac arrest from traumatic cardiac tamponade; PEA after tension pneumothorax excluded
Cardiac tamponade present in **up to 90%** of penetrating cardiac injuries
Beck's Triad: muffled heart sounds + JVD + hypotension
Kussmaul's sign: pulsus paradoxus (BP drop >10 mmHg with inspiration) + paradoxical increase in JVD
POCUS can identify pericardial effusion with RV collapse
Blind Technique (Subxiphoid):
Sterile prep of subxiphoid region
18-gauge spinal needle at **45° angle** directed toward **left shoulder**
Advance while withdrawing plunger; stop when blood returns
Remove up to 50 mL, then reassess; 25–30 mL can produce immediate improvement
Continue in 25 mL increments until hemodynamic improvement
Stabilize needle in place or convert to flexible catheter via Seldinger technique
ECG-Guided Technique:

Alligator clip from ECG lead V1 (12-lead) or lead II (3-lead) to proximal metal portion of needle
ST elevation on monitor = myocardial contact → back needle out slightly
Ultrasound-Guided Technique:
Identify point of maximal effusion → most superficial access site (may differ from subxiphoid)
Guide needle with US before, during, and after procedure; check for reaccumulation
Complications:
May delay thoracotomy (which is the definitive procedure but usually unavailable prehospital)
Injury to myocardium or coronary vessels

Spinal Motion Restriction (SMR)

Background
Terminology shift: "spinal motion restriction" (SMR) > "spinal immobilization": true immobilization is unachievable
Recent data: lack of evidence for c-collars and long spine boards in maintaining alignment; documented adverse effects with routine immobilization
Joint position statement (NAEMSP + ACEP + ACS-COT, 2018): defines indications and emphasizes limiting spine board use
No role for SMR in penetrating trauma:
Spinal cord injuries from bullets are complete at injury or stable; immobilization not beneficial
C-collar interferes with neck wound surveillance
Spine board may restrict breathing with concurrent chest injury

Indications for SMR (Blunt Trauma)
Acutely altered level of consciousness (GCS <15 or evidence of intoxication)
Midline neck or back pain and/or tenderness
Focal neurological signs or symptoms (numbness, motor weakness)
Anatomical deformity of the spine
Distracting circumstances or injury impairing reliable examination

Selective SMR — Clinical Decision Rules
NEXUS Low-Risk Criteria (absence of ALL = may forego SMR):
No focal neurologic deficit
No midline spinal tenderness
Normal level of alertness
No evidence of intoxication
No distracting painful injury
Canadian C-Spine Rule
Any high-risk factor mandating radiography? (age ≥65, dangerous mechanism, extremity paresthesias)
Any low-risk factor allowing safe ROM assessment? (simple rear-end MVC, ambulatory since injury, delayed neck pain, no midline tenderness)
Can patient actively rotate neck 45° left and right?
Both rules studied prehospital: found safe and effective
Both originally designed for ED radiography decisions, not field clearance: context matters

Cervical Collar Application
Rigid cervical collars only: soft collars provide minimal motion restriction and have **no place in prehospital care**
Evidence: Stifneck-type collars outperform Philadelphia and hard extrication collars in all planes except extension
Sizing: hand measurement from shoulder to chin determines appropriate collar height
Collar should prevent flexion/extension but allow mouth opening
Complications: respiratory compromise, elevated intracranial pressure (caution in head-injured patients), expanding hematoma concealment, discomfort

Spinal Motion Restriction Devices

Device	Key Points	Technique Highlights
Long spine board	Useful for patient movement; NOT for transport: remove for transport; associated with discomfort, pressure ulcers, aspiration risk, respiratory compromise	Log roll; strap chest first, then waist, thighs, legs; head last
Scoop stretcher	Avoids log roll/lift; closes under patient; watch for pinching at buttocks/shoulders	Close head hinge first, then foot; strap same order as long board
Vacuum mattress	Best for comfort and customized fit; superior for long-distance/extended transports; can be used on a long board or carried with straps	Lay flat, place patient, pump firm, mold to patient, vacuum air out
KED (Kendrick Extrication Device)	Upright patient extrication; order of straps: middle torso → bottom torso → legs → top torso → head	After extrication, disconnect leg straps; patient secured to stretcher/board while in KED

Children:
Consider undamaged car seat for adequately restrained infants not requiring further care
Short board with torso padding (head proportionally larger than in adults: pad under torso to maintain neutral alignment)
KED described as "ideal" for pediatric immobilization due to versatility
SMR can reduce forced vital capacity even in healthy children: be prepared to assist ventilation
Pregnancy ≥20 weeks:
Wedge board 15° toward left lateral decubitus to prevent aortocaval compression by gravid uterus
Padding:
Reduces discomfort and interface pressures
Closed-cell foam, air mattress overlays, and vacuum mattresses all show benefit
Limit time on rigid devices, especially for elderly and high-risk patients

Key Mnemonics
FOOSH: Fall On OutStretched Hand → mechanism for elbow posterolateral dislocation, scaphoid fractures, Colles fracture
NEXUS (to clear without SMR: ALL must be absent):
No focal neuro deficit
Excluded altered mentation
Xcluded intoxication
Unimpaired (no distracting injury)
Spine tenderness absent
Beck's Triad for Tamponade:
Muffled heart sounds
JVD
Hypotension
(Muffled Jugular Hypotension)

PRIORITY PATCH

If no clinical improvement after needle thoracostomy, consider: (1) no tension pneumothorax was present, or (2) catheter did not reach pleural space. Attempt the alternative site (2nd ICS MCL vs. midaxillary line).
Pericardiocentesis is the prehospital procedure of choice for cardiac tamponade. As little as 25–30 mL removal can produce dramatic hemodynamic improvement. POCUS can confirm the diagnosis and guide needle placement.
NEXUS and Canadian C-spine rules were validated in the ED, not prehospital. However, multiple prehospital studies show both can function safely when used by trained EMS providers. Know the criteria for NEXUS cold.

⚡PULSE CHECK

QUESTION 1

Which structure is at risk if the needle is placed too high during a needle thoracostomy at the 2nd ICS?

A. Internal mammary artery
B. Subclavian vessels
C. Abdominal viscera
D. Brachial plexus

Answer: B

Subclavian vessels are at risk if the needle is placed too high at the 2nd ICS/MCL approach. Abdominal viscera are at risk if too caudal with the lateral approach. Insert perpendicular to skin over the superior rib surface to avoid the neurovascular bundle.

QUESTION 2

If needle thoracostomy produces no clinical improvement in a suspected tension pneumothorax, the next best step is:

A. Repeat needle thoracostomy at the same site
B. Consider alternative site or longer needle (6--6.5 cm) for obese patients
C. Administer IV fluid bolus and reassess
D. Intubate the patient immediately

Answer: B

Standard 4.4 cm needles fail in approximately 50% of patients due to chest wall thickness. If no improvement, use a longer needle (6--6.5 cm) or an alternative site (4th--5th ICS, midaxillary line). Catheters can also migrate out of the pleural space.

QUESTION 3

The cricothyroid membrane for surgical airway access is located:

A. Superior to the thyroid cartilage
B. Inferior to the thyroid cartilage, between thyroid and cricoid cartilage
C. At the first tracheal ring below the cricoid
D. Between the first and second tracheal rings

Answer: B

The cricothyroid membrane is inferior to the thyroid cartilage, between the thyroid and cricoid cartilages. A 6.0 ETT or trach tube is used. Prehospital success rates are variable (17--93%) due to skill decay from infrequent performance.

41 Physiology of Pregnancy

General Critical Care and Trauma Considerations

Systematic assessment must be **modified based on gestational stage**
Critically ill/injured mother **≥ 24 weeks** requires transport to facility capable of nonstress testing:
Continuous fetal HR and uterine contraction monitoring for **minimum 4 hours**
Extend to **24 hours** if placental abruption is suspected
Digital vaginal exam in patients > 20 weeks should be avoided prehospital and preferably until ultrasound rules out placenta previa

Airway

Capillary engorgement → swelling of pharynx, larynx, and trachea
Mucosal edema from elevated estrogen and increased extracellular fluid → can worsen with URI, fluid overload, or preeclampsia
Increased risk of regurgitation and aspiration from delayed gastric emptying
Always have **suctioning devices immediately ready**
Use standardized Mallampati scoring; assess mouth opening, atlantooccipital extension, mandibular protrusion
Keep a **smaller sized ETT** and **gum elastic bougie** on hand
Standard monitoring: SpO_2 and end-tidal CO_2 waveform capnography

Breathing

Upward displacement of diaphragm → decreased FRC → **rapid desaturation** with any medical or traumatic insult
Position as **upright as feasible** to decrease abdominal pressure on thorax
Use nonrebreather or BiPAP to ensure adequate fetal oxygenation
Be prepared for difficult airway issues **before** deciding to intubate

Circulation

Increased blood volume allows **initial compensation for major blood loss followed by rapid deterioration**
Treat aggressively with **IV fluid resuscitation** to prevent hypotension
Watch for **pulmonary edema and third spacing** with crystalloid infusions (lower oncotic pressure)
Permissive hypotension resuscitation approach should NOT be applied to traumatic pregnant patients
Given relative anemia of pregnancy, blood transfusion may be needed **earlier** in resuscitative efforts
Place hypotensive pregnant patient in **left lateral decubitus position (tilted 15–30 degrees)** using sandbags or pillows to prevent IVC compression and improve venous return
Vasopressors may be used if necessary to correct shock

Toxicology: Carbon Monoxide

Fetus at **higher risk** of adverse effects than mother:
Higher affinity of fetal hemoglobin for CO than maternal hemoglobin
Increased minute ventilation and endogenous CO production from fetus
Treatment: remove from source, high-flow **100% oxygen**, consider hyperbaric oxygen (HBO)
HBO Indications in Pregnancy:
COHb level ≥ 20%
Syncope
Coma
Altered mental status/confusion
Seizures
Metabolic acidosis
Fetal distress (tachycardia, decreased beat-to-beat variability, decelerations)
Cardiotoxicity
Any neurologic findings in the mother (especially cerebellar)

Cardiovascular

ECG changes normal in pregnancy: Q waves in leads II, III, aVF; flat or inverted T waves in III, V1–V3; **most common: slight left axis deviation** (altered heart position as diaphragm is increasingly elevated)
Dependent edema common in third trimester (decreased SVR + IVC pressure from growing uterus)
Hematocrit falls because plasma volume increases **more than** red blood cell mass → **physiological anemia of pregnancy**
Pregnant women are **4–5 times more likely** to develop DVT or PE; risk extends to **12 weeks postpartum**

VTE prevalence: 0.5–3 per 1,000 pregnancies; death: 1.1 per 100,000 pregnancies → **leading cause of maternal mortality in the US**

Respiratory

Diaphragm rises up to **4 cm** above usual resting position; chest diameter increases **≥ 2 cm**
FRC decreases **20%** in second and third trimesters (decreased expiratory reserve volume and residual volume)
Resting minute ventilation increases nearly **50%** in third trimester (tidal volume increases up to 40%; respiratory rate relatively unchanged)
Arterial pCO_2 falls to **27–32 mmHg** → respiratory alkalosis + compensatory renal bicarbonate excretion → normal to slightly alkalotic pH (**7.4–7.45**)

Hematologic

Hypercoagulable state: increases clotting factors I, II, VII, VIII, IX, XII; decreases fibrinolysis; decreases protein S and activated protein C

Gastrointestinal

Appendicitis: most common non-obstetric indication for surgery in pregnancy (0.5–1 per 1,000; most common in second trimester); appendix displaced superiorly and posteriorly by uterus; higher complication rate (preterm labor, perforation, peritonitis)
Consider appendicitis in pregnant patient with **right-sided abdominal pain** (RLQ, RUQ, or right flank)
Cholecystitis: second most common non-obstetric surgical emergency (1 in 1,600 to 1 in 10,000 pregnancies); Murphy's sign may not be present depending on gestational age and habitus

Renal

Renal plasma flow increases **60–80%**
Pyelonephritis: most common serious bacterial infection in pregnancy; associated with higher risk of premature delivery (< 32 weeks)
UTIs associated with preterm labor and infant low birthweight

Endocrine

Insulin sensitivity **30–70% lower** in late pregnancy
Gestational diabetes affects **6%** of US pregnant women
DKA affects **0.5–3%** of diabetic pregnancies; fetal loss rates **10–25%** per episode; can occur at blood glucose **< 200 mg/dL** (lower than nonpregnant threshold): pregnancy is a ketosis-prone, accelerated starvation state
Neonates of mothers with gestational diabetes at high risk of **neonatal hypoglycemia** minutes after delivery → anticipate and have dextrose protocol

Neurology

Stroke affects **30 per 100,000** pregnancies (about three times higher than in nonpregnant young adult population)
Preeclampsia affects approximately **4% of pregnancies** in the US; **second leading cause of maternal mortality worldwide**
Magnesium sulfate: recommended prehospital treatment for eclamptic seizures; in-hospital, early delivery recommended

PRIORITY PATCH

► See chapter content for high-yield points.

⚡PULSE CHECK

QUESTION 1

Which of the following is an expected physiologic change in pregnancy?

A. Decreased oxygen consumption
B. Increased hematocrit
C. Increased blood volume by 40 -- 50%
D. Decreased gastric emptying

Answer: C

Of the available choices, only C is correct. The distractors are in the opposite direction

QUESTION 2

Delayed gastric emptying in pregnancy increases the risk of which airway complication?

A. Difficult laryngoscopy from mucosal edema
B. Aspiration from increased gastric volume
C. Rapid desaturation from decreased FRC
D. ETT misplacement from anatomical distortion

Answer: B

Delayed gastric emptying increases gastric volume and aspiration risk in pregnancy. The upward displacement of the diaphragm decreases FRC causing rapid desaturation. Always have suction immediately ready and a smaller ETT and bougie on hand.

QUESTION 3

The increased blood volume of pregnancy allows compensation before rapid decompensation at approximately what percentage of blood loss?

A. 10--15%
B. 20--25%
C. 30--35%
D. 40--50%

Answer: C

Pregnancy allows compensation for approximately 30--35% blood loss before hemodynamic compromise --- then rapid decompensation. This means a pregnant trauma patient may appear stable while the fetus is already compromised.

42 Emergencies of Pregnancy

Evaluation and Transport

Key history elements:
Estimated due date or weeks of gestation
Last menstrual period
Number of previous pregnancies (Gravidity)
Number and type of deliveries (Parity)
Contraction intervals, membrane rupture, bleeding
Complications with current and prior pregnancies (GDM, preeclampsia, preterm labor)
Transport in third trimester: **left lateral decubitus position** to displace uterus from major vessels and maximize cardiac output
Always choose closest destination with **emergency obstetric capabilities**; longer travel times associated with increased mortality and adverse outcomes

Miscarriage

Most common complication of early pregnancy; **~15–20%** of clinically evident pregnancies
80% occur before 12th week
Primary EMS focus: **psychological support**
Transport any passed tissue with patient to receiving facility
If hemorrhagic shock: large-bore IV; resuscitate with NS boluses and/or blood products to **goal SBP 90 mmHg**

Ectopic Pregnancy

Implantation outside endometrial cavity; occurs in approximately **1–2%** of pregnancies; some studies report up to **2.6%**
Prevalence among women presenting to ED with first-trimester vaginal bleeding or abdominal pain: as high as **18%**
Leading cause of first-trimester pregnancy-related death; accounts for **6% of all maternal deaths**
Ruptured ectopic accounts for **2.7%** of all pregnancy-related deaths and is the **leading cause of hemorrhage-related mortality**
Risk factors: PID history, prior tubal surgery, prior ectopic, IUD use (past 2 years), ART, cigarette smoking, alcohol use, starting contraceptives at younger age, age > 35, many lifetime partners, diethylstilbestrol exposure during pregnancy
Classic presentation (around 6–8 weeks): abdominal pain + vaginal bleeding + delayed menses: fewer than half present classically
Kehr's sign (referred left shoulder pain): **late sign** indicating diaphragmatic irritation from hemoperitoneum
Symptoms more likely to indicate **miscarriage** than ectopic
Hypovolemia, tachycardia, hypotension, diaphoresis, shock = **late signs** of ruptured ectopic with hemoperitoneum
Management:
Large-bore IV access; resuscitate with crystalloids and blood products
Free abdominal fluid on prehospital ultrasound in woman with abdominal pain and hypotension → increased suspicion for ruptured ectopic

Placental Abruption

Premature separation of placenta from uterine wall; complicates approximately **1%** of births
Causes **10–20% of perinatal deaths**; accounts for **~30%** of second-half-of-pregnancy bleeding
Associated with **~6%** of all trauma cases; **20–25%** of major trauma cases in pregnancy
Usually manifests within **6–48 hours** after trauma; can occur up to **5 days later**
Prior abruption increases risk **15–20-fold** in subsequent pregnancies
Presentation:
Abdominal pain (68%) and bleeding (35%): classic, but **neither must be present**
Degree of vaginal bleeding **does NOT correlate** with severity of abruption
"Silent" abruption: hemorrhage contained between placenta and uterine wall; no vaginal bleeding
Uterine tenderness; uterus may feel hard; high-frequency low-amplitude contractions
"Seat belt sign" correlates with abruption incidence of **71.4%** vs. **4.3%** without
Management:
Two large-bore IVs; **maximum 1 L NS** before blood products
Transport to OB-capable facility (trauma center if traumatic mechanism)
Vasopressors: **last resort** (reduce uterine blood flow → fetal hypoxia)
TXA: WOMAN trial showed survival benefit in postpartum hemorrhage without increased thromboembolic risk when given within 3 hours; O+ whole blood prehospital transfusion described in case report; more research needed before standard practice

Placenta Previa

Placenta overlies or is proximate to internal cervical os
Classic presentation: **painless bleeding** in late second or early third trimester; some have painful bleeding; some have no antepartum bleeding
Prior C-sections markedly increase risk: relative risk 4.5× (1 prior C/S) → 44.9× (4 prior C/S)
Management:
Two large-bore IVs; expeditious transport to hospital; close monitoring en route
Fluid resuscitation (NS and/or blood products) if shock

Hypertension During Pregnancy

Condition	Definition
Gestational hypertension	New BP ≥ 140/90 mmHg; resolves postpartum
Preeclampsia	Gestational HTN + proteinuria, end-organ dysfunction, or uteroplacental dysfunction ≥ 20 weeks
Preeclampsia with severe features	SBP ≥ 160 or DBP ≥ 110 + end-organ damage
Eclampsia	New-onset grand mal seizures in woman with preeclampsia

Preeclampsia

Affects **4% of pregnancies** in the US; **second leading cause of maternal mortality worldwide**
Symptoms: edema, visual disturbance, headache, epigastric pain
Maternal risks: HELLP syndrome, seizures, 2–4× long-term HTN risk, double cardiovascular mortality risk
Fetal risks: IUGR, preterm birth, oligohydramnios, placental abruption, fetal distress, fetal death
Definitive treatment is delivery (decision made by obstetrician)
Severe hypertension (SBP ≥ 160 or DBP ≥ 110 sustained ≥ 15 minutes): treat with **IV labetalol and hydralazine** (or **oral nifedipine** if no IV access)
Prehospital priority: supportive treatment and **rapid transport** to appropriate institution

Eclampsia

< 1% of preeclamptic patients; may occur **in the absence of preeclampsia**
In **10–15%** of eclamptic patients: hypertension absent or modest and/or proteinuria not detected
Incidence: **~1 in 3,250 pregnancies** in the US
> 90% present after gestational week 28; can present as early as week 16; as late as **23 days postpartum**
Up to **25%** of eclamptic seizures occur in the **postpartum period**
Other features: nausea, vomiting, hyperreflexia, severe headaches, altered mental status; rarely cortical blindness
Management:
During convulsion: prevent hypoxia; support maternal respiratory and cardiovascular function; prevent maternal injury and aspiration
First seizure: do NOT treat with anticonvulsants unless progresses to status epilepticus
Once stable: initiate **magnesium sulfate** to prevent seizure recurrence
Magnesium Sulfate:
Loading dose: **4–6 g IV over 15–20 minutes**
Maintenance: **2 g/hour continuous infusion**
Superior to phenytoin: reduces recurrent seizures by **67%**
Superior to diazepam: reduces recurrent seizures by **52%**
Also lowers maternal mortality
Magnesium Toxicity (in order of progression):
Loss of deep tendon reflexes ← earliest sign; use serial reflex exams as screening tool
Respiratory depression
Muscular paralysis
Respiratory arrest
Maternal cardiac arrest
Antidote: **calcium gluconate**; delay of repeat magnesium administration is generally sufficient

PRIORITY PATCH

Any woman of reproductive age with abdominal pain or vaginal bleeding has ruptured ectopic pregnancy **until proven otherwise**. Passage of tissue does NOT distinguish miscarriage from ectopic pregnancy.
Digital vaginal examination with placenta previa may provoke catastrophic hemorrhage and must NOT be performed: prehospital or in the ED: until placental location confirmed by ultrasound.

⚡PULSE CHECK

QUESTION 1

Ectopic pregnancy accounts for approximately which percentage of first-trimester pregnancy-related deaths?

A. 2--3%
B. 6%
C. 12%
D. 20%

Answer: B

Ectopic pregnancy accounts for 6% of all maternal deaths and is the leading cause of first-trimester pregnancy-related death. It occurs in 1--2% of pregnancies (up to 2.6% in some studies). Risk factors: prior PID, tubal surgery, previous ectopic.

QUESTION 2

How should a third-trimester patient be positioned during transport to maximize cardiac output?

A. Supine with legs elevated
B. Right lateral decubitus
C. Left lateral decubitus
D. Semi-Fowler's position

Answer: C

Left lateral decubitus displaces the uterus from the major vessels (IVC and aorta), maximizing venous return and cardiac output. Supine position allows aortocaval compression, reducing cardiac output by up to two-thirds at term.

QUESTION 3

Painless vaginal bleeding during the third trimester should raise concern for:

A. Placental abruption
B. Placenta previa
C. Preterm labor
D. Cervical polyp

Answer: B

Placenta previa classically presents with painless vaginal bleeding in the third trimester (low-lying placenta covering the cervical os). Avoid digital vaginal exam in patients >20 weeks until US rules out previa. Abruption presents with painful bleeding and rigid uterus.

43 Normal Childbirth

Key Definitions

Gravidity: number of times a woman has been pregnant
Parity: number of times a woman has given birth to a fetus ≥ 20 weeks (regardless of outcome); twin pregnancy with both delivered = **G1P1**
Term pregnancy: ≥ 37 weeks; **Viable:** 22–26 weeks
Naegele's rule: add 9 months and 7 days to first day of LMP; tends to **overestimate** gestational age
Fundal height: cm from pubic symphysis to top of fundus ≈ weeks of gestation ± 2 weeks; **20-week pregnancy reaches the umbilicus**
First fetal movements: weeks **18–20** (primigravid); ~2 weeks earlier in multiparous

Ultrasound in Pregnancy

Earliest definitive finding: **gestational sac** at 5–6 weeks transabdominal: **gestational sac alone is NOT diagnostic for IUP**
First definitive sign of IUP: **yolk sac within gestational sac** (~6–7 weeks)
FHTs: **120–160 bpm** after 12 weeks; first detected ~6 weeks on US (may take up to 12 weeks)
IUP on US essentially **excludes ectopic** (exception: heterotopic pregnancy if patient had fertility treatment)
Suspicious for ectopic: pelvic free fluid + adnexal mass other than simple cyst; gestational sac/yolk sac/fetal pole with heartbeat outside uterus confirms ectopic

Evaluation of the Pregnant Patient

Obtain: LMP, contraceptive use, gravidity and parity, complications with current and prior pregnancies
If delivery imminent: frequency and strength of contractions, fluid/water leakage
If signs of active labor (contractions, urge to push, membrane rupture, other concerning signs): **perform visual examination of the perineum**
Medical directors should craft written protocols specifying when perineal inspection is appropriate: failure to document opens clinician, medical director, and system to liability

Imminent Delivery

All women in active labor: **IV access prehospital**
Ensure adequate personnel for resuscitative care of both mother and baby
Ready obstetric and neonatal resuscitation equipment
Maintain access to direct medical oversight

Delivery of the Neonate

If fetal head visible at vaginal outlet: prepare for imminent delivery
Position patient in **lithotomy position**
Apply **constant pressure** on anterior and posterior aspects of head; **slow delivery** to decrease perineal damage
Typically: occiput passes below symphysis pubis; face pointed toward anus
After head delivers: gently wipe mouth and nose; assess for **nuchal cord** (Chapter 44)
Baby rotates; gentle downward pressure until anterior shoulder passes under symphysis; upward movement delivers posterior shoulder; rest of body typically without difficulty; gentle traction may be applied
Double-clamp and cut the umbilical cord
Separation of infant from mother = beginning of Stage 3

Post-Delivery: Care of the Neonate

Normally begins to breathe and cry almost immediately
If stable: place on mother's chest (decreases heat loss; encourage nursing → oxytocin release → aids placenta delivery)
NRP recommendation: rapidly **warm, dry, and stimulate** → rouses majority of slow-to-cry neonates
Most newborns do not require suctioning
If warming and stimulating fail: begin resuscitation per **NRP algorithm with positive-pressure ventilation**
IV access: **rarely necessary prehospital**; if needed: consider **umbilical vein cannulation or IO**
If baby in distress: **immediate transport** to closest appropriate facility

APGAR Score (1- and 5-minute assessments)

Sign	0	1	2
Heart rate	Absent	Below 100	Over 100
Respiratory effort	Absent	Slow, irregular	Good, crying
Muscle tone	Flaccid	Some flexion of extremities	Active motion
Reflex irritability	No response	Grimace	Vigorous cry
Color	Blue, pale	Body pink, extremities blue	Pink

4–6 at 1 minute: mildly to moderately depressed; < 3: severely depressed

Delivery of the Placenta (Stage 3)

Usually occurs spontaneously **10–30 minutes** after fetal delivery
Do NOT delay transport for placenta delivery
Signs of impending placenta delivery: uterus becomes globular, umbilical cord lengthens, gush of blood (marks placental separation)
External fundal massage assists contractions
Avoid strong traction on umbilical cord: risk of umbilical cord separation or uterine inversion
Expected blood loss throughout delivery: approximately **500 mL**

Pregnant Trauma Patient

Basic trauma life support per local protocols; airway, hemorrhage control, supplemental O_2, immobilization, rapid transport to appropriate facility (ideally with both trauma and OB capabilities)
Seemingly minor trauma (ground-level falls, low-speed MVCs) can cause abruption → EMS protocols should reflect this
Normal physiologic vital sign changes of pregnancy can **mimic shock** (elevated resting HR in 3rd trimester); elevated blood volume allows massive blood loss before decompensation
All supine pregnant trauma patients in 2nd and 3rd trimester should be transported tilted **15–30 degrees to the left** (patient on left side or towels/wedge under right hip)

Pregnant Patient in Cardiac Arrest (> 20 Weeks)

Scene interventions minimal; immediate transport is highest priority: perform all interventions en route
Primary directive: **maximize maternal resuscitative measures**
Hand placement for compressions: **unchanged** in pregnant patient
If uterus above umbilicus (2nd or 3rd trimester): **manual displacement of uterus** by pushing upper right border **~1.5 inches from midline**: preferred over tilting
Do not delay medication administration or defibrillation
Medication doses and defibrillation energy: **same as nonpregnant adult patients**
Assume a **difficult airway**; increased risk of hypoxia
Success of perimortem C-section correlates directly with **length of time in cardiac arrest**
Good neurologic outcome of neonate reported when cesarean done within **first 5 minutes** of arrest

PRIORITY PATCH

► See chapter content for high-yield points.

⚡PULSE CHECK

QUESTION 1

The earliest definitive sign of an intrauterine pregnancy on ultrasound is:

A. Gestational sac at 5--6 weeks
B. Yolk sac within the gestational sac at approximately 6--7 weeks
C. Fetal heartbeat at 6 weeks
D. Fetal pole at 5 weeks

Answer: B

The earliest definitive sign of IUP is the yolk sac within the gestational sac (~6--7 weeks). A gestational sac alone is NOT diagnostic for IUP. IUP on US essentially excludes ectopic pregnancy (exception: heterotopic pregnancy in fertility patients).

QUESTION 2

A 20-week pregnancy fundus should be located at approximately which anatomic landmark?

A. Pubic symphysis
B. Midway between symphysis and umbilicus
C. The umbilicus
D. Midway between umbilicus and xiphoid

Answer: C

Fundal height in cm from pubic symphysis ≈ weeks of gestation ± 2 weeks. A 20-week pregnancy reaches the umbilicus. This provides a rapid equipment-free gestational age estimate.

QUESTION 3

Normal fetal heart rate after 12 weeks of gestation is:

A. 80--100 bpm
B. 100--120 bpm
C. 120--160 bpm
D. 160--200 bpm

Answer: C

Normal FHT: 120--160 bpm after 12 weeks. First detectable by US at approximately 6 weeks. Values outside this range (bradycardia or tachycardia) suggest fetal distress.

44 Childbirth Emergencies

General Considerations

Unattended OOH deliveries: **< 2% of all US births**
Most are uncomplicated vertex presentations requiring only routine supportive care
Maternal risk factors for unattended OOH delivery: **younger maternal age, multiparity, poor prenatal care**: same factors associated with prematurity and higher fetal morbidity/mortality
Increasing trend of unattended OOH deliveries and increasing medicolegal burden
Request additional resources as soon as multiple gestation, abnormal presentation, or any other emergency is identified
Some systems may require transport of mother and neonate to **separate receiving facilities**

Umbilical Cord Prolapse

Cord descends through cervix **prior to presenting fetal part** → fetal compression of cord as it traverses birth canal
Incidence: approximately **0.5–1%** of all deliveries
Risk factors: **abnormal fetal presentation (especially breech)**, lack of prenatal care, twinning (especially second-born twin), GDM/macrosomia
Associated with lower APGAR scores and increased perinatal mortality
Management:
Using gloved hand, **gently elevate the presenting part** off the cord (continuous)
Cover exposed cord in **moist sterile towel**
Position mother in **knee-chest position or steep Trendelenburg** to reduce cord pressure
If Doppler unavailable: attempt to detect cord pulsation; **carefully avoid further compression** during palpation
Expedite transport; **C-section typically required** in-hospital
Rapid prehospital delivery may be less likely due to association with abnormal presentations

Breech Presentation

Occurs in **3–4%** of deliveries overall; in one prehospital series, 2.5% (both were feet-first; neither completely delivered in the field)
Three types:
Frank: both hips flexed, knees extended; legs lie along abdomen
Complete: flexion at both hips and knees
Incomplete/Footling: one or both hips not flexed; foot is presenting part
Complications: incomplete cervical dilation by small presenting part, **entrapment of after-coming head**, cord prolapse (especially with footling), injury from excessive traction
Management:
Once recognized: **initiate transport immediately**; goal is OB expertise and C-section capability
If delivery in progress: wrap presenting part in towel; **support but do not elevate** (unless cord prolapse)
Avoid traction
Alert for cord prolapse
If only after-coming head remains: place fingers on **maxilla to gently flex neck** to facilitate passage

Shoulder Dystocia

Failure of fetal shoulders to deliver following delivery of fetal head; **0.2–3%** of deliveries
Some define as > 60 seconds between head and shoulder delivery + maneuvers beyond simple traction
Physiologically: **impaction of fetal shoulders against maternal pelvic inlet**: most commonly anterior shoulder against pubic symphysis
Most common cause: **fetal macrosomia**; no reliable prediction criteria
"Turtle sign": retrograde movement of fetal head back into introitus after initial delivery
True emergency: brachial plexus injury, neck injury, asphyxiation
If relieved within a few minutes: incidence of permanent injury **0–1.6%**; perinatal death **0–2.9%**
Prehospital Maneuver Sequence:
McRoberts maneuver: hyperflexion of maternal hips → increased sacral-pubic distance; relieves approximately **40%** of dystocias alone
Add **suprapubic pressure** (NOT fundal): combined success nearly **60%**
Gaskin maneuver (all-fours): roll patient to hands and knees
If unresolved: **immediate emergency transport**
EMS physicians may attempt Woods corkscrew or Rubin maneuvers (or direct crews via oversight); guiding crews via radio/cell phone in these situations will likely be **difficult**
Zavanelli maneuver (replacement of fetus into uterus) may be attempted by EMS physician as temporizing measure; very rarely used in

US
Episiotomy may facilitate maneuvers but will NOT relieve bony impaction
Deliberate fracture of fetal clavicle described but not universally accepted

Vaginal Hemorrhage (Postpartum)

Postpartum hemorrhage: **leading cause of maternal death worldwide**
Primary PPH: first 24 hours; complicates **4–6%** of pregnancies; incidence rising
Secondary PPH: > 24 hours to weeks post-delivery (most often retained products ± infection; coagulopathies)
80% of primary hemorrhage: **uterine atony**
Other causes: coagulopathies (e.g., Von Willebrand disease), retained placenta, placenta accreta, uterine inversion, pelvic/vaginal trauma
Management:
Fundal massage (circular motion): first maneuver for all clinician levels
Large-bore IV access; fluid resuscitation per protocol for hemorrhagic shock
Specialty/CCT units may administer: **oxytocin (first-line)**, misoprostol (Cytotec), methylergonovine (Methergine), prostaglandins (Hemabate, Dinoprostone)
TXA: WOMAN trial showed survival benefit without increased thromboembolic events when given **within 3 hours** of bleeding onset (WHO recommendation); failed to show same benefit in resource-rich setting with available blood transfusion; prehospital use in systems with existing TXA for other indications may be considered
Prehospital blood transfusion: low-titer O+ whole blood prehospital transfusion reported in case report for severe maternal hemorrhage; more research needed before standard practice
Do NOT attempt cord traction to deliver placenta prehospital (risk of exacerbating hemorrhage and precipitating uterine inversion)
Perineal laceration bleeding: **direct pressure** ± vaginal packing
Inverted uterus: direct medical oversight may consider manual reduction in remote locations with prolonged transport times

PRIORITY PATCH

Cervical dilation >4 cm = likely delivery en route; crowning = deliver on scene; do NOT delay for transport when delivery is imminent
Shoulder dystocia: **McRoberts maneuver** (hyperflexion of hips) + suprapubic pressure first; do NOT apply fundal pressure
Postpartum hemorrhage: uterine atony = #1 cause; bimanual uterine massage + oxytocin if available; fundus should be firm and below umbilicus
Nuchal cord: reduce over head if loose; if tight, clamp and cut before delivery of shoulders
Umbilical cord prolapse: immediate transport in knee-chest position; manually elevate presenting part off cord; do NOT replace cord

⚡PULSE CHECK

QUESTION 1

Umbilical cord prolapse requires which immediate prehospital intervention?

A. Cut and clamp the cord to prevent further compression
B. Gently elevate the presenting part off the cord with a gloved hand continuously
C. Immediate field delivery
D. Apply a wet dressing to the cord and position the patient supine

Answer: B

Immediate intervention: elevate the presenting fetal part off the cord continuously with a gloved hand. Position: knee-chest or steep Trendelenburg. Cover exposed cord with moist sterile towel. C-section is typically required --- expedite transport.

QUESTION 2

Which fetal presentation is most commonly associated with cord prolapse?

A. Occiput anterior
B. Vertex at term
C. Breech
D. Transverse lie in a term singleton

Answer: C

Breech presentation is most commonly associated with cord prolapse. Other risk factors: twinning (especially second-born), macrosomia/GDM, and lack of prenatal care.

QUESTION 3

What percentage of U.S. births are unattended out-of-hospital deliveries?

A. <2%
B. 5--10%
C. 15%
D. 25%

Answer: A

Fewer than 2% of U.S. births are unattended OOH. Most are uncomplicated vertex presentations requiring only routine supportive care. Maternal risk factors: younger age, multiparity, poor prenatal care.

45 Perimortem Cesarean Section

Background

Term traced to 715 BC: Roman king Numus Pompilius: "Lex Regis" → "Lex Caesare"
Leading causes of maternal mortality have shifted to **trauma, cardiac disease, and embolism**: mother and infant generally healthy until sudden maternal cardiac arrest
Landmark review (Katz et al., 1986): 269 cases 1879–1985; **188 infants (70%) survived**; most surviving infants delivered within 5 minutes; all but one neurologically intact infant delivered within **15 minutes**
"4-minute rule": initiate PMCS within **4 minutes** of maternal arrest; deliver by **5 minutes**: widely referenced
Follow-up review (Katz et al., 38 cases 1985–2004): **13 of 38 mothers** discharged in good condition
Einav et al. (94 cases): PMCS beneficial to mothers in **31.7%** of cases; performing within **10 minutes** of arrest associated with better maternal outcomes

Rationale: PMCS Benefits Maternal Resuscitation

Gravid uterus at term compresses great vessels → reduces cardiac output by **two thirds**
CPR already produces only ~one third of normal cardiac output
CPR in supine pregnant patient = approximately **10% of normal cardiac output**
Emptying uterus:
Alleviates IVC compression → improves venous return
Redistributes uterine blood (**up to 25% of cardiac output** at term) to other organs
Increases maternal FRC → better oxygenation
Term also used: **"resuscitative hysterotomy"**
Katz landmark review: **12 cases** of sudden, often profound improvement in mother's condition once uterus emptied

Indications

Maternal cardiac arrest **≥ 20–24 weeks gestation** (fundus at or above umbilicus) with no ROSC from standard resuscitation + left uterine displacement
For any **obviously gravid uterus** deemed clinically large enough to cause aortocaval compression
May be considered **sooner** (< 4 minutes) when maternal injury is obviously non-survivable and resuscitative efforts deemed futile (Class I, LOE C-LD, AHA)
AHA and ACOG recommend it for maternal cardiac arrest when fundal height at or above umbilicus (≥ 20 weeks gestation) with no ROSC from usual resuscitative measures + left uterine displacement: to be performed within **4 minutes** of onset of maternal arrest if no ROSC (Class IIa, LOE C-EO)
Gestational age identification: fundus is 2 cm (one fingerbreadth) above umbilicus per 2 weeks past 20 weeks; many experts recommend PMCS for any gestation **two fingerbreadths above umbilicus (~24 weeks)**
Do NOT waste time assessing fetal viability: multiple neurologically intact infants have survived after **> 25 minutes** of maternal arrest

Performance in the Field

Limited cases reported in modern literature
At least **three field PMCS cases by physicians on EMS teams** reported in the US
Outside nursing or paramedic scope of practice, even with online medical control
At least one case of paramedics performing the procedure: "appropriateness of the clinicians was brought into question"
If transport to hospital achievable within 5 minutes of maternal arrest: **consider transporting** with ongoing resuscitation rather than performing in field
After PMCS: may need to cease maternal resuscitation to focus on resuscitating the infant (limited resources)
Liability:
Since described in 1986: **no physician in the US has been held liable** for performing PMCS, even against family wishes
At least two lawsuits brought against physicians for **failure** to perform PMCS
Even if infant survives with neurologic deficits: multiple neurologically intact infants have survived after even prolonged maternal resuscitation

Procedure

Equipment:
Essential: scalpel (No. 10 blade), toothed forceps, bandage scissors, bulb syringe, 2 umbilical clamps, towels, suction device with suction catheter, packing gauze
Optional: antiseptic solution, 2 medium Richardson retractors, bladder retractor, Foley catheter, needle driver, No. 0 or No. 1 delayed-

absorbable suture on large needle
Steps:
Continue CPR throughout; **manual leftward uterine displacement** (not tilting): preferred per AHA; two EMS clinicians may alternate compressions and displacement
Defibrillate for appropriate rhythms at **same dosages as other adults** (Class I, LOE C)
Generous vertical midline incision from pubis to umbilicus following linea nigra; extend to xiphoid if needed; Pfannenstiel incision is an alternative: operator should use incision most familiar
Carry through fascial layers into peritoneal cavity; Richardson retractors for access
Displace bladder caudally manually or with retractor; if distended and obstructing: stab incision to drain (can repair if mother successfully resuscitated)
Short vertical incision in lower uterine segment, just cephalad to bladder
Extend cephalad with **bandage scissors** with fingers inside uterus shielding fetus
If placenta in anterior wall: **transect through it** (accept blood loss for rapid delivery)
Remove retractors to avoid infant injury
Vertex: insert hands between fetal head and pubic symphysis; elevate head and shoulders out of incision
Breech/transverse or incision too high: feet-first delivery
Suction mouth/nose with bulb syringe; clamp and cut cord at level of mother's abdomen; assess, clean, warm infant; resuscitate as appropriate
Palpate uterus for twins; remove placenta if resources allow
Pack or suture uterus (**No. 0 or No. 1 delayed-absorbable, continuous locking one-layer closure**) if maternal circulation restored; can apply direct pressure to aorta to minimize pelvic vessel bleeding

Ethical and Legal Considerations

Consent not required: failing to perform results in near-certain death for both
Peer-reviewed resuscitation guidelines (AHA/ACOG) provide recourse for EMS physician in making decision
Provide critical incident stress management to EMS personnel within 24 hours; individual follow-up determined case by case; community resources sought for family members

Education

Courses: **ALSO** (Advanced Life Support in Obstetrics), **MOET** (Managing Obstetric Emergencies and Trauma), **ALARM** (Advances in Labor and Risk Management)
Following MOET introduction in Netherlands: PMCS rate increased from **0.36 to 1.6 procedures/year**
All EMS physicians who may encounter this should be trained to perform PMCS

PRIORITY PATCH

► See chapter content for high-yield points.

⚡PULSE CHECK

QUESTION 1

The '4-minute rule' for PMCS references which landmark evidence?

A. Fetal brain death occurs at exactly 4 minutes of hypoxia
B. Most surviving infants were delivered within 5 minutes; all neurologically intact infants within 15 minutes
C. CPR efficacy drops to zero at 4 minutes without PMCS
D. Maternal ROSC is impossible after 4 minutes without surgery

Answer: B

Katz landmark review (269 cases, 1879--1985): most surviving infants delivered within 5 minutes; all but one neurologically intact infant within 15 minutes. PMCS also benefits the mother by relieving IVC compression and redistributing up to 25% of cardiac output.

QUESTION 2

The primary maternal hemodynamic benefit of PMCS (resuscitative hysterotomy) is:

A. Reduces oxygen demand by eliminating placental circulation
B. Alleviates IVC compression and redistributes uterine blood flow (~25% of CO)
C. Allows direct cardiac massage
D. Reduces intrathoracic pressure improving CPR depth

Answer: B

The gravid uterus at term compresses the IVC, reducing cardiac output by 2/3 in the supine position. CPR in a supine pregnant patient produces approximately 10% of normal CO. Emptying the uterus alleviates IVC compression and redistributes up to 25% of cardiac output.

QUESTION 3

The Einav review of 94 PMCS cases showed benefit to what percentage of mothers?

A. 5--10%
B. 20--25%
C. 31.7%
D. 50%

Answer: C

Einav et al.: PMCS beneficial to mothers in 31.7% of cases, with better outcomes when performed within 10 minutes of arrest. The Katz follow-up review found 13 of 38 mothers discharged in good condition.

46 Principles of Toxicology

Epidemiology

Over 2 million human toxic exposures reported annually to poison control centers
>93% from residences; routes: ingestion (83%), skin (7%), inhalation (6%), eye (4%)
76% unintentional; 59% pediatric (under age 20)
Self-poisoning case fatality rate ~0.5% in modern healthcare settings; up to 10–20% in developing world

General Approach to the Poisoned Patient

Do NOT limit differential: comatose patient smelling of alcohol may have intracranial hemorrhage
ABCs first; then targeted history (substance, dose, route, time, intent)
Odors may provide clues:
Bitter almonds → cyanide
Garlic → organophosphates
Rotten eggs → hydrogen sulfide
Freshly mowed hay → phosgene
Fruity → isopropanol/acetone

Toxidromes

Toxidrome	Pupils	VS	Key Features	Examples
Cholinergic	Miosis	↓HR, ↓BP	SLUDGE/DUMBELS, bronchospasm, seizures	Organophosphates, carbamates, nerve agents
Anticholinergic	Mydriasis	↑HR	Dry/flushed skin, urinary retention, delirium	Diphenhydramine, TCAs, atropine
Sympathomimetic	Mydriasis	↑HR, ↑BP	Diaphoresis, agitation, hyperthermia	Cocaine, amphetamines, ephedrine
Opioid	Miosis	↓RR, ↓HR	CNS/respiratory depression	Heroin, fentanyl, oxycodone
Sedative-hypnotic	Miosis	↓RR	CNS depression without miosis (benzos); ataxia	Benzodiazepines, barbiturates, EtOH
Serotonin syndrome	Mydriasis	↑HR, ↑Temp	Clonus, agitation, diaphoresis, tremor	SSRIs + MAOIs, linezolid, tramadol

Cardiac Toxicity

Sodium channel blockade → QRS widening → VT → VF (TCAs, cocaine, diphenhydramine)
Terminal 40ms rightward axis deviation = TCA poisoning
Treatment: sodium bicarbonate
QTc prolongation → Torsades de pointes (antipsychotics, some antibiotics, methadone)

Decontamination

Skin: Remove clothing/jewelry first (removes ~80% of contamination); copious water flush
Eye: Copious irrigation with water or NS; do not delay transport
GI (rare prehospital use):
Activated charcoal: useful within 1 hour of ingestion of certain agents; NOT for alcohols, iron, lithium, strong acids/bases
Whole bowel irrigation: NOT prehospital
Gastric lavage: NOT routine prehospital
Poison control center: available to any provider 24/7; 1-800-222-1222 (US)

Key Antidotes

Toxin	Antidote
Opioids	Naloxone 0.4–2 mg IV/IM/IN (repeat PRN)
Organophosphates	Atropine (large doses) + Pralidoxime (2-PAM) within 24–48h
Benzodiazepines	Flumazenil (use cautiously: seizure risk in chronic users)
TCA/Na-channel blocker	Sodium bicarbonate (1–2 mEq/kg IV)
Beta-blockers	Glucagon + high-dose insulin + lipid emulsion
Calcium-channel blockers	Calcium + high-dose insulin + lipid emulsion
Cyanide	Hydroxocobalamin (preferred prehospital) or sodium nitrite + sodium thiosulfate
Carbon monoxide	100% O_2; HBO if severe
Digoxin	Digoxin-specific Fab fragments
Hypoglycemia (sulfonylurea)	Dextrose + octreotide

PRIORITY PATCH

Cholinergic (miosis, SLUDGE): organophosphates/nerve agents
Anticholinergic (mydriasis, dry/flushed skin): diphenhydramine, TCAs
Serotonin syndrome: clonus + diaphoresis + hyperthermia
Titrate atropine to **drying secretions**, NOT pupil size
Cyanide antidote prehospital: **hydroxocobalamin** (not sodium nitrite if CO coingestant)

⚡PULSE CHECK

QUESTION 1

Which toxidrome features miosis, bradycardia, bronchospasm, and SLUDGE symptoms?

A. Sympathomimetic
B. Anticholinergic
C. Cholinergic
D. Serotonin syndrome

Answer: C

Cholinergic toxidrome (organophosphates, carbamates, nerve agents): miosis, bradycardia, hypotension, bronchospasm, SLUDGE (Salivation, Lacrimation, Urination, Defecation, GI distress, Emesis), seizures. Anticholinergic is the opposite: mydriasis, tachycardia, dry/flushed skin.

QUESTION 2

A patient starts a new SSRI while taking tramadol and develops hyperthermia, clonus, and agitation. What is the diagnosis?

A. Anticholinergic toxidrome
B. Neuroleptic malignant syndrome
C. Serotonin syndrome
D. Sympathomimetic overdose

Answer: C

Serotonin syndrome: mydriasis, tachycardia, hyperthermia, clonus (pathognomonic), agitation, diaphoresis, tremor. Caused by serotonergic excess (SSRIs + MAOIs, linezolid, tramadol). Clonus distinguishes it from NMS and anticholinergic toxidrome.

QUESTION 3

A freshly mowed hay odor at a hazmat scene suggests exposure to which agent?

A. Hydrogen sulfide
B. Cyanide
C. Phosgene
D. Organophosphates

Answer: C

Freshly mowed hay = phosgene. Bitter almonds = cyanide. Garlic = organophosphates. Rotten eggs = hydrogen sulfide. Fruity/acetone = isopropanol. These olfactory clues are directly testable.

47 Treatment and Evaluation of Specific Toxins

Carbon Monoxide

Most common cause of poisoning death in US; produced by incomplete combustion
CO has 200–250× greater affinity for Hgb than O_2 → carboxyhemoglobin → tissue hypoxia
Also binds cytochrome oxidase → cellular hypoxia
Pulse oximetry is UNRELIABLE: cannot distinguish oxyhemoglobin from carboxyhemoglobin
Symptoms: headache, nausea, confusion, syncope → coma, death
Cherry-red skin and CO levels do NOT reliably predict severity
Treatment:
Remove from environment; 100% O_2 via tight-fitting NRB (reduces half-life from 5h to 1h)
HBO: consider for: LOC, neurologic signs, CO-Hgb >25% (>15% in pregnancy), cardiac involvement, extremes of age
HBO ideally within 6 hours; effective up to 24 hours
Maternal CO levels do NOT correlate with fetal levels: lower threshold for HBO in pregnancy

Cyanide

Generated by burning of natural/synthetic substances (house fires, industrial)
Mechanism: uncouples oxidative phosphorylation → cellular asphyxia despite adequate O_2 delivery
Signs: dyspnea, headache, nausea, anxiety → syncope, apnea, death; lactic acidosis
Bitter almond odor and cherry-red skin are NOT reliable signs
Consider CN if: smoke inhalation + lactic acidosis + hemodynamic/respiratory compromise not responding to O_2
Antidotes:
Hydroxocobalamin (5g IV adult; 70 mg/kg peds over 15 min): preferred prehospital; scavenges CN directly forming cyanocobalamin; causes urine/skin discoloration and transient hypertension; INCOMPATIBLE with sodium thiosulfate in same line
Sodium thiosulfate (12.5g adult; 0.42 g/kg peds): converts CN to thiocyanate; safest empiric agent when CN exposure uncertain
Sodium nitrite (300mg adult IV over 2–3 min): produces methemoglobin; avoid if significant smoke inhalation (worsens O_2 carrying capacity)

Organophosphates and Carbamates

Acetylcholinesterase inhibitors → excess ACh → SLUDGE (Salivation, Lacrimation, Urination, Defecation, GI distress, Emesis) + bronchospasm + bradycardia + miosis + seizures
DUMBELS mnemonic: Defecation/Diarrhea, Urination, Miosis, Bradycardia/Bronchospasm/Bronchorrhea, Emesis, Lacrimation, Salivation/Secretions
PPE is critical: organophosphates absorb through skin; Level B/C minimum
Treatment:
Atropine: 2–4 mg IV q5–10 min until secretions dry (titrate to bronchospasm/bronchorrhea, NOT pupil size)
Pralidoxime (2-PAM): 1–2g IV over 15–30 min; must be given within 24–48h of exposure before "aging" (irreversible binding) occurs
Benzodiazepines for seizures

Hydrogen Sulfide

Similar mechanism to CN (cytochrome oxidase inhibition); stronger odor but "odor fatigue" possible
Most tragic cases: responders overcome trying to rescue unconscious victims
Most common agent in "chemical suicides" (usually in vehicles)
Treatment: supportive: remove from environment + 100% O_2; hydroxocobalamin may have benefit

Irritant Gases (Chlorine, Ammonia, Phosgene)

Water solubility predicts which airways are affected:
High water solubility (Cl_2, NH_3): upper airway: immediate irritation, warning properties
Low water solubility (phosgene, NO_2): lower airway: delayed pulmonary edema 6–24h
Treatment: remove from exposure, supportive, watch for delayed pulmonary edema with low-solubility agents

Vesicants (Blister Agents)

Sulfur mustard, lewisite, nitrogen mustards
PPE: Level A required for hot zone operations
Decontamination: most internalized within 15 min on tissue, but persist on objects: remove ALL clothing/jewelry
Symptoms: blistering skin, corneal damage, airway necrosis with vapor inhalation
Sulfur mustard: penetrates most materials, no warning properties, delayed symptom onset, bone marrow suppression

Lewisite: contains arsenic; faster onset than mustard; antidote: BAL (dimercaprol)

PRIORITY PATCH

CO poisoning: pulse ox is **unreliable** (can't distinguish oxyhgb from carboxyhgb)
Cyanide prehospital: **hydroxocobalamin** -- does not worsen O_2 capacity
Sodium nitrite: avoid if concurrent CO exposure (worsens O_2 carrying)
Atropine for organophosphates: titrate to **drying secretions**, not pupils
2-PAM must be given within 24--48h before irreversible aging occurs

⚡PULSE CHECK

QUESTION 1

100% O2 via NRB mask in CO poisoning reduces the carboxyhemoglobin half-life from approximately 5 hours to:

A. 3 hours
B. 2 hours
C. 1 hour
D. 30 minutes

Answer: C

100% O2 via NRB reduces COHb half-life from ~5 hours (room air) to ~1 hour. HBO further reduces it to 20--30 minutes. HBO is indicated for LOC, neurologic signs, COHb >25% (>15% in pregnancy), cardiac involvement, and extremes of age.

QUESTION 2

Cyanide poisoning should be suspected in which clinical scenario?

A. Organophosphate exposure with SLUDGE symptoms
B. Smoke inhalation with lactic acidosis not responding to oxygen
C. CO poisoning with cherry-red skin
D. Methemoglobinemia with cyanosis

Answer: B

Consider cyanide in smoke inhalation + lactic acidosis + hemodynamic/respiratory compromise not responding to O2. Cyanide uncouples oxidative phosphorylation. Bitter almond odor and cherry-red skin are NOT reliable signs.

QUESTION 3

A known side effect of hydroxocobalamin administration for cyanide poisoning is:

A. Severe hypotension
B. Reddish discoloration of urine and skin
C. Hemolysis and methemoglobinemia
D. QT prolongation

Answer: B

Hydroxocobalamin causes reddish/pink discoloration of urine, skin, and mucous membranes, plus transient hypertension. It is INCOMPATIBLE with sodium thiosulfate in the same IV line. Adult dose: 5g IV over 15 minutes.

48 Cold Exposure Illness and Injury

Hypothermia

Stage	Core Temp	Clinical Features
Mild	90–95°F (32–35°C)	Shivering, impaired judgment, ataxia
Moderate	82–90°F (28–32°C)	Shivering stops, CNS depression, cardiac dysrhythmias
Severe	<82°F (<28°C)	Coma, VF risk, apparent death

"No one is dead until warm and dead": but NOT always practical
Conditions incompatible with life: core temp <50°F (10°C), cold-water submersion >1 hour, obvious fatal injuries, chest wall too rigid for CPR
EMS more likely to encounter "urban hypothermia": chronic, combined with comorbidities, medications, substance abuse, malnutrition
Heat loss mechanisms: radiation (40% of all heat loss), evaporation, conduction, convection (wind chill = function of square of wind velocity up to 40 mph)
Prehospital treatment:
Gentle handling: VF risk with movement in moderate/severe hypothermia
Remove wet clothing; insulate from ground/environment
Forced warm air, full-body blanket, electric heater with rigid torso cover
AVOID warm/hot water immersion (shown to increase mortality)
Cardiac monitoring; treat VF with defibrillation (may need higher energy or repeated attempts)
Active rewarming: warmed humidified O_2; warmed IV fluids (do not delay transport for this)
Acute environmental (primary) hypothermia: may not need evacuation if cold stress eliminated
Severe hypothermia: evacuate with minimal jostling/bumping

Frostbite

Freezing cold injury to peripheral tissues; most common in toes, fingers, ears, nose
Superficial (frostnip to superficial frostbite): skin white/waxy, firm surface but soft deeper; no blisters immediately
Deep frostbite: full thickness; hard, wooden texture; clear blisters → hemorrhagic blisters (worse prognosis)
Prehospital: do NOT rewarm if risk of refreezing: "freeze, thaw, refreeze" causes worse injury than delayed rewarming
Rewarm in 40–42°C (104–108°F) circulating water IF no refreezing risk and pain management available
Ibuprofen 400mg q12h + aloe vera applied topically shown to improve outcomes (inhibit thromboxane)
Do NOT rub or massage frostbitten tissue

Cold-Water Immersion

Hypothermia + drowning risk; survival with prolonged submersion documented in children
Mammalian diving reflex: bradycardia + peripheral vasoconstriction: protective in cold-water submersion
Rescue carefully: circulatory collapse possible on removal from water ("rescue death")

PRIORITY PATCH

Hypothermia: "Not dead until warm and dead" -- do not pronounce in field
Severe (<28°C): handle gently -- movement triggers VF
Warm/hot water immersion: **increases mortality** -- use 40–42°C
Frostbite: **no rewarming if refreezing risk**; ibuprofen + aloe vera
Moderate (28–32°C): shivering STOPS -- classic wrong answer is "shivering present"

⚡PULSE CHECK

QUESTION 1

At which core temperature does shivering typically cease, marking progression from mild to moderate hypothermia?

A. 95°F (35°C)
B. 90°F (32°C)
C. 85°F (29°C)
D. 80°F (27°C)

Answer: B

Shivering ceases at approximately 90°F (32°C) --- mild/moderate boundary. Mild: 90--95°F (shivering, impaired judgment). Moderate: 82--90°F (shivering stops, CNS depression, dysrhythmias). Severe: <82°F (coma, VF risk).

QUESTION 2

Which rewarming method should be avoided due to an association with increased mortality?

A. Forced warm air blanket
B. Warmed humidified oxygen
C. Warm water immersion
D. Warmed IV fluids

Answer: C

Warm/hot water immersion has been shown to increase mortality in hypothermia --- avoid it. Preferred methods: remove wet clothing, insulate from environment, forced warm air, warmed IV fluids, warmed humidified O2. Gentle handling is essential due to VF risk with movement.

QUESTION 3

Withholding resuscitation in a hypothermic patient will result in which combination of findings?

A. Core temperature of 55°F (13°C) with no pulse
B. Core temperature of 85°F (29°C) with no pulse
C. Cold water submersion of 20 minutes
D. Cardiac rhythm showing atrial fibrillation

Answer: A

Core temperature <50°F (10°C) is one condition incompatible with life. Others: cold submersion >1 hour, obviously fatal injuries, chest wall too rigid for CPR. Core temperature 55°F (13°C) is below the threshold --- no resuscitation is appropriate.

49 Heat-Related Illness

Heat Illness Spectrum

Condition	Core Temp	CNS	Treatment
Heat edema	Normal	Normal	Elevation; self-limited
Heat cramps	Normal	Normal	Rest, oral/IV fluids, salt replacement
Heat syncope	Normal/slightly ↑	Brief LOC	Supine position, hydration
Heat exhaustion	<40°C (<104°F)	Near-normal	Remove from heat, cooling, IV fluids
Heat stroke	>40°C (>104°F)	**Abnormal**	Aggressive cooling + IV fluids + hospital

Heat stroke = hyperthermia + CNS dysfunction ← the defining feature
Classic: elderly/debilitated, unable to respond to ambient heat over days; often anhidrosis
Exertional: healthy active adults in hot/humid conditions; may still be diaphoretic
Other features: cardiac dysrhythmias, pulmonary edema, tachycardia, shock; core temp often 40–44°C
Treatment: benzodiazepines for seizures; aggressive cooling is the intervention that saves lives

Cooling Methods

Cold water immersion (ice water or cold water bath): fastest cooling method; gold standard for exertional heat stroke
Evaporative cooling (misting + fans; misting + ambulance AC): practical prehospital option
Ice packs to groin/axilla/neck: adjunctive
Target core temp of 38.3°C before stopping aggressive cooling (overshoot risk)
For exertional heat stroke: delay transport for initiated cooling is reasonable (10–20 min); if measuring core temp, cool to 39°C

Pathophysiology

Inability to dissipate heat → cellular damage, inflammatory cascade, multi-organ dysfunction
Sweat rate can reach 1.5 L/hour; heat acclimatization (10–14 days) improves efficiency
Heat index (apparent temperature) combines temperature + humidity: more predictive than temp alone

PRIORITY PATCH

Heat stroke = hyperthermia + **CNS dysfunction**; dry skin NOT required
Exertional heat stroke: patient may still be **diaphoretic**
Fastest cooling: **cold water immersion**
Stop cooling at **38.3°C** (overshoot risk)

⚡PULSE CHECK

QUESTION 1

What feature defines heat stroke and distinguishes it from severe heat exhaustion?

A. Core temperature >40°C (104°F)
B. Diaphoresis
C. CNS dysfunction (altered mental status)
D. Tachycardia with hypotension

Answer: C

Heat stroke = hyperthermia + CNS dysfunction. Temperature alone does not define it. Classic heat stroke may present with anhidrosis; exertional heat stroke may still be diaphoretic. Both require aggressive cooling.

QUESTION 2

The gold standard cooling method for exertional heat stroke is:

A. Evaporative cooling with misting fans
B. Ice packs to neck, axilla, and groin
C. Cold water immersion (ice water or cold water bath)
D. Cold IV saline infusion

Answer: C

Cold water immersion is the gold standard and fastest cooling method for exertional heat stroke. Delaying transport to initiate cooling is reasonable (10--20 min). Stop aggressive cooling at 38.3°C to avoid temperature overshoot.

QUESTION 3

To prevent overshoot, aggressive cooling should be stopped at which core temperature?

A. 40°C
B. 39°C
C. 38.3°C
D. 37°C

Answer: C

Stop aggressive cooling at 38.3°C to prevent overshoot into hypothermia. Some protocols use 39°C for exertional heat stroke when core temperature is continuously monitored. Cooling too aggressively past target risks hypothermic complications.

50 High-Altitude Illnesses

Physiology

Physiologic changes begin at ~1500m (5000 ft)
At 3500m: each breath contains ~60% of sea-level O_2 (barometric pressure ↓; O_2 concentration remains 21%)
At 5000m: ~50% of sea-level O_2
Responses: ↑EPO, ↑RR and TV (respiratory alkalosis → kidneys secrete bicarb → allows further ↑ minute ventilation), dehydration, peripheral edema, periodic breathing

High-Altitude Illnesses

Condition	Onset	Key Features	Treatment
AMS (Acute Mountain Sickness)	Hours to days at ≥2500m	Headache, fatigue, nausea: "hangover"; no neuro deficits	Halt ascent; acetazolamide 250mg PO BID; NSAIDs/ondansetron for symptoms
HACE (High-Altitude Cerebral Edema)	1–3 days; can progress from AMS in 12h	Ataxia, altered LOC, severe headache/vomiting	**Immediate descent ≥500–1000m**; dexamethasone 8mg then 4mg q6h; supplemental O_2 (SpO_2 >90%); portable hyperbaric chamber
HAPE (High-Altitude Pulmonary Edema)	2–4 days	Dry cough → productive, dyspnea at rest, cyanosis, crackles	**Most common cause of altitude death**; immediate descent; nifedipine 30mg SR; supplemental O_2; portable hyperbaric chamber

Portable hyperbaric chamber (Gamow bag): simulates descent; effective when descent impossible
Acetazolamide (Diamox): carbonic anhydrase inhibitor; causes mild metabolic acidosis → stimulates ventilation; also used for prophylaxis

PRIORITY PATCH

HAPE = most common cause of altitude **death** (not HACE)
HACE: dexamethasone. HAPE: nifedipine. AMS: acetazolamide
HACE and HAPE: **immediate descent ≥500–1000m** first
Gamow bag: simulates descent when evacuation impossible
Acetazolamide: causes metabolic acidosis → stimulates ventilation

⚡PULSE CHECK

QUESTION 1

Which high-altitude illness is the most common cause of altitude-related death?

A. Acute Mountain Sickness (AMS)
B. High-Altitude Cerebral Edema (HACE)
C. High-Altitude Pulmonary Edema (HAPE)
D. Altitude-related cardiac arrhythmia

Answer: C

HAPE is the most common cause of altitude death --- not HACE. HAPE: dry cough → productive, dyspnea at rest, cyanosis, crackles (2--4 days after ascent). Treatment: immediate descent, nifedipine 30 mg SR, supplemental O2, portable hyperbaric chamber.

QUESTION 2

Dexamethasone is the treatment for which altitude illness?

A. AMS
B. HACE
C. HAPE
D. All altitude illnesses equally

Answer: B

HACE: dexamethasone 8 mg then 4 mg q6h + immediate descent ≥500--1000m + supplemental O2. HAPE: nifedipine 30 mg SR. AMS: acetazolamide 250 mg PO BID. Immediate descent is the universal first step for both HACE and HAPE.

QUESTION 3

Acetazolamide prevents AMS by which mechanism?

A. Suppressing ventilatory drive for better acclimatization
B. Causing mild metabolic acidosis that stimulates increased ventilation
C. Directly reducing pulmonary artery pressure
D. Decreasing CSF production

Answer: B

Acetazolamide (carbonic anhydrase inhibitor) causes mild metabolic acidosis by increasing bicarbonate excretion. This stimulates ventilation and improves oxygenation at altitude. It is the primary pharmacological prophylaxis for AMS.

51 Effects of Flight

Gas Laws Governing Flight Physiology

Law	Statement	EMS Relevance
Boyle's Law	P×V = constant (at constant temp)	Gas expands at altitude → pneumothorax enlarges, air splints expand, ETT cuffs expand, bowel gas expands
Dalton's Law	Total pressure = sum of partial pressures	FiO_2 requirement increases at altitude; O_2 toxicity at high partial pressures
Henry's Law	Gas dissolved in liquid ∝ partial pressure	Nitrogen narcosis; decompression sickness during rapid ascent
Charles' Law	V/T = constant (at constant pressure)	Cold temperatures at altitude affect gas volumes

Physiologic Effects of Flight

Hypoxia: begins at ~8000 ft in unpressurized aircraft; commercial aircraft cabins pressurized to equivalent of 6000–8000 ft
Time of Useful Consciousness (TUC): at 18,000 ft = 20–30 min; at 25,000 ft = 3–5 min
Supplemental O_2 required for patients at altitude
Spatial disorientation: vestibular system unreliable in flight; "leans," vertigo; most dangerous at night/IMC
Noise and vibration: interfere with auscultation, assessment; hearing protection required
Fatigue and circadian disruption: affects crew performance; CAMTS/CAAS fatigue management standards
Gravitational forces (G-forces): during maneuvers; Gz forces (head-to-foot) → pooling of blood inferiorly

Stresses of Flight (DEATH mnemonic)

D: Dehydration
E: Exhaustion/fatigue
A: Anxiety/emotional stress
T: Temperature (hypothermia at altitude)
H: Hypoxia

Air Medical Considerations

Fixed-wing vs. rotor-wing: different altitude profiles, pressurization capabilities, speed, cost
Patient considerations: pneumothorax should be evacuated BEFORE flight (will expand); air in endotracheal tube cuffs should be replaced with saline; clamshell/open pneumothorax: seal/tube before flight
Landing zones: minimum 100×100 ft clear, firm, level; 300 ft preferred; no overhead wires

PRIORITY PATCH

D: Dehydration
E: Exhaustion/fatigue
A: Anxiety/emotional stress
T: Temperature extremes
H: Hypoxia

⚡PULSE CHECK

QUESTION 1

A patient with a known pneumothorax is transported by helicopter. Which gas law explains why clinical deterioration may occur at altitude?

A. Dalton's Law --- partial pressure of oxygen decreases
B. Boyle's Law --- gas expands as pressure decreases at altitude
C. Henry's Law --- nitrogen forms bubbles on ascent
D. Charles' Law --- cold temperatures reduce gas volume

Answer: B

Boyle's Law: as altitude increases and pressure decreases, gas volume expands. A pneumothorax will enlarge at altitude, potentially converting to tension. ETT cuffs, air splints, and bowel gas also expand at altitude.

QUESTION 2

In the DEATH mnemonic for stresses of flight, 'H' stands for:

A. Hypothermia
B. Hypoxia
C. Hypotension
D. Hearing loss

Answer: B

DEATH: D=Dehydration, E=Exhaustion/fatigue, A=Anxiety/emotional stress, T=Temperature (hypothermia at altitude), H=Hypoxia. Hypoxia begins at approximately 8,000 feet in unpressurized aircraft.

QUESTION 3

Time of Useful Consciousness at 25,000 feet is approximately:

A. 20--30 minutes
B. 10--15 minutes
C. 3--5 minutes
D. 30--60 seconds

Answer: C

TUC at 25,000 ft = 3--5 minutes. At 18,000 ft = 20--30 minutes. This is critical for crew management during decompression emergencies. Commercial aircraft are pressurized to equivalent of 6,000--8,000 feet.

52 Diving Injury

Gas Laws in Diving

Boyle's Law: As pressure increases with depth, gas volume decreases; on ascent, gas expands
1 ATM at surface → 2 ATM at 33 fsw (feet of seawater) → gas volume halved
Explains barotrauma: if gas trapped during ascent, it expands and causes injury
Henry's Law: Gas dissolved in liquid ∝ partial pressure → at depth, more N_2 dissolves in blood/tissue → rapid ascent → N_2 bubbles form ("the bends")
Dalton's Law: Partial pressure of each gas increases with depth → O_2 toxicity, N_2 narcosis at depth

Barotrauma (Boyle's Law injuries)

Occur during **descent** (squeeze) or **ascent** (reverse squeeze)
Ear squeeze (middle ear barotrauma): most common diving injury; pain, hearing loss, possible TM rupture; cold water in middle ear → caloric stimulation → vertigo → disorientation → drowning risk
Sinus squeeze: pain over sinuses during descent; epistaxis possible
Pulmonary overpressurization (POPS): occurs on ascent with breath holding; gas expands → alveolar rupture → pneumothorax, pneumomediastinum, subcutaneous emphysema, **arterial gas embolism (AGE)**
AGE = most feared diving emergency; sudden LOC on surfacing; treat as stroke; position supine (not Trendelenburg); 100% O_2; immediate HBO

Decompression Sickness (DCS): "The Bends"

Henry's Law: N_2 supersaturation in tissues during ascent → bubble formation
Type I DCS (mild): joint/limb pain ("the bends"), skin mottling, lymphedema; no CNS involvement
Type II DCS (serious): spinal cord (most common CNS) → paraplegia; cerebral → stroke-like; pulmonary ("chokes") → dyspnea, chest pain; inner ear ("staggers") → vertigo, hearing loss
Treatment:
100% O_2 (washout of N_2)
Horizontal positioning (supine); avoid Trendelenburg (worsens cerebral edema)
IV fluids (rehydration)
Hyperbaric oxygen (HBO): definitive treatment; contact Divers Alert Network (DAN): 1-919-684-9111
Do NOT delay transport to HBO for symptom improvement on O_2 alone
Risk factors: rapid ascent, repetitive dives, dehydration, flying after diving (<12–18h), obesity, patent foramen ovale

Nitrogen Narcosis

N_2 acts as anesthetic at depth (usually >100 fsw)
"Martini effect": impaired judgment and euphoria; self-limited on ascent
Treatment: ascent

Other Diving Emergencies

Freediving/breath-hold blackout: hypoxic LOC on ascent from hyperventilation before dive; prevent by avoiding hyperventilation before dive; lifeguard observation required
Near-drowning associated with diving: water aspirated; treat per drowning protocol

PRIORITY PATCH

AGE: occurs on ascent with breath-holding; sudden LOC on surfacing
Both AGE and DCS: 100% O_2 + IV fluids + **HBO**; call DAN 1-919-684-9111
Positioning: **supine/horizontal** -- NOT Trendelenburg (worsens cerebral edema)
Do NOT fly within **12--18h** of diving
Don't stop transport for O_2-only symptom improvement -- still needs HBO

⚡PULSE CHECK

QUESTION 1

Arterial gas embolism (AGE) is the most feared diving emergency and requires which prehospital patient positioning?

A. Trendelenburg to prevent cerebral migration
B. Left lateral decubitus
C. Supine (flat)
D. Semi-sitting

Answer: C

AGE patients should be positioned supine --- not Trendelenburg (no longer recommended). Treat like stroke: 100% O2, immediate HBO. AGE presents as sudden LOC on surfacing from breath-holding ascent (pulmonary overpressurization).

QUESTION 2

Type II decompression sickness differs from Type I by involving:

A. Only joint and limb pain
B. Spinal cord or cerebral involvement
C. Resolution with rest and oral hydration alone
D. Middle ear barotrauma

Answer: B

Type I DCS (mild): joint/limb pain, skin mottling, lymphedema --- no CNS involvement. Type II DCS (serious): spinal cord (most common) or cerebral involvement with paralysis/neurologic deficits. Both require HBO therapy.

QUESTION 3

The most common diving injury overall is:

A. Arterial gas embolism
B. Pulmonary overpressurization
C. Middle ear barotrauma (ear squeeze)
D. Type I decompression sickness

Answer: C

Middle ear barotrauma (ear squeeze) is the most common diving injury overall. It occurs during descent, causing pain, hearing loss, and possible TM rupture. Cold water in the middle ear causes caloric stimulation → vertigo → disorientation → drowning risk.

53 The Special Needs of Children

Epidemiology

Pediatric calls ≈ **13%** of ambulance runs but cause disproportionate anxiety
Most common chief complaints (PECARN data):
Traumatic injury (29%) → General illness (10%) → Respiratory distress (9%) → Behavioral/psychiatric (8.6%) → Seizure (7.4%)
Top chief complaint **under 1 year**: respiratory distress; **1–18 years**: trauma

Pediatric Assessment Triangle (PAT)

Completed in **30–60 seconds**, no equipment needed: observe from across the room
Pediatric Assessment Triangle (PAT) Components

Component	What to Assess
Appearance	TICLS: **T**one, **I**nteractiveness, **C**onsolability, **L**ook/Gaze, **S**peech/Cry
Work of Breathing	Abnormal sounds, abnormal position (tripod/sniffing), retractions, nasal flaring
Circulation to Skin	Pallor (↓ blood flow), mottling (vasoconstriction), cyanosis

Primary Survey (ABCDEs)

A: Patent? Self-managing? Jaw thrust, OPA, NPA, BVM, SGA, ETT
B: Rate, effort, sounds: beware slow rate (signals failure, not just calm)
C: HR, pulse quality, capillary refill (<2–3 s), skin temp/color. BP often inaccurate: don't rely on it alone. **Hypotension = late sign of shock**
D: AVPU (Awake, Voice, Pain, Unresponsive): GCS not required
E: Full exposure to identify all injuries; prevent hypothermia

Vital Signs by Age

Age	Weight (kg)	RR (min–max)	HR (min–max)	Systolic BP (min–max)
Premie/Newborn	1–5	30–60	90–190	50–70
6 months	7	24–40	85–180	65–106
1 year	10	20–40	80–150	72–110
3 years	15	20–30	80–140	78–114
6 years	20	18–25	70–120	80–116
8 years	25	18–25	70–110	84–122
12 years	40	14–20	60–110	94–136
15 years	50	12–20	55–100	100–142
18 years	65	12–18	50–90	104–148

Key Number: *Minimum systolic BP for children >1 year =* ***70 + (2 × age in years)***

Weight Estimation

Broselow Tape (most common): red end at head, read at heel → weight, drug doses, equipment size. Based on lean/50th percentile weight: **underestimates obese children**
Handtevy Tape: similar concept, includes mobile platform
Mercy TAPE: uses mid-upper arm circumference + humeral length: more accurate in obese children
For obese children: use **one color zone higher** for drug dosing only; length still best for equipment sizing
Lipid-soluble drugs (e.g., epinephrine): dose by **lean/ideal** body weight. If calculated dose exceeds adult max → use adult max

Developmental Approach

Age	Key Behaviors	Evaluation Tips
<2 months	Limited repertoire	Keep warm, soothing voice
2–6 months	Eye contact, follow objects	Evaluate in parent's lap
6–12 months	Stranger anxiety, crawling	Keep with parent, use pacifier/toy
1–3 years (Toddler)	"No," fearful, curious	Use name, distraction, parents
3–5 years (Preschool)	Creative, fear of being alone	Distraction, let them hold stethoscope
School-age	Fear of loss of control	Establish trust, offer privacy
Adolescent	Peer-focused, risk-taker	Respect privacy, speak directly

Children with Special Health Care Needs

15% of children in U.S. have special needs (2013 data)
Always determine **baseline developmental level and behavior** from caregiver: ask "What is different from normal?"
Ask about:
Emergency information form ("keep it in the freezer")
"Go bag" with special equipment
Preferred hospital (may require contacting medical oversight for non-protocol transport)

Consent

Children under 18 **cannot consent** (legal minors)
Emancipated minor (state-specific, generally includes): married, active military, not living at home and self-supporting, pregnant/has a child in some states → can consent and refuse
Medically emancipated: homeless, runaway: can consent for their child but not always for themselves
Mature minor (court-declared adult, usually >14): can refuse transport if not on psychiatric hold and has capacity
Implied/emergency exception: guardian unavailable + emergency condition + delay would be harmful + treat only emergency condition → treat and transport; document extensively, contact medical oversight
Guardian refusal: must have capacity; contact medical oversight; if emergency treatment needed anyway → law enforcement for temporary protective custody (allows transport for evaluation, **not** treatment of non-life-threatening conditions)

PRIORITY PATCH

Appearance + Work of Breathing abnormal → respiratory problem
Appearance + Circulation abnormal → circulatory problem
All three abnormal → critically ill; act immediately
Hypotension in children = **late and ominous**; shock without low BP is common
Min SBP (>1 yr): **70 + (2 × age)**

⚡PULSE CHECK

QUESTION 1

The three components of the Pediatric Assessment Triangle (PAT) are:

A. Pulse, respiration, color
B. Appearance, work of breathing, circulation to skin
C. AVPU, respiratory rate, heart rate
D. Skin color, capillary refill, mental status

Answer: B

PAT: Appearance (TICLS: Tone, Interactiveness, Consolability, Look/Gaze, Speech/Cry), Work of Breathing (sounds, position, retractions, flaring), Circulation to Skin (pallor, mottling, cyanosis). Completed by observation from across the room in 30--60 seconds.

QUESTION 2

The most common pediatric EMS chief complaint in patients aged 1--18 years is:

A. Respiratory distress
B. Seizure
C. Traumatic injury
D. Behavioral emergency

Answer: C

Traumatic injury is the most common complaint in children ages 1--18 (29% of pediatric EMS calls per PECARN data). In infants <1 year, respiratory distress is top. Pediatric calls account for approximately 13% of ambulance runs.

QUESTION 3

In pediatric patients, hypotension represents what stage of shock?

A. Early compensated shock
B. A normal finding not requiring intervention
C. Late decompensated shock
D. An artifact of inaccurate field BP measurement

Answer: C

Hypotension is a LATE sign in pediatric shock. Children maintain normal BP through tachycardia and increased vascular resistance despite significant blood loss. By the time BP drops, the child is in decompensated shock. Rely on HR, pulse quality, capillary refill, and skin temperature.

54 Pediatric Medical Priorities

Respiratory & Airway

Anatomy Differences

Large occiput → neck flexion → use **shoulder roll** and sniffing position
Under 6 months: **obligate nose breathers** → nasal suctioning critical
Large tongue → most common cause of upper airway obstruction
Narrowest point: **subglottic region** (vs. cords in adults)
Smaller bronchioles → ↑ resistance, mucous trapping → retractions, tachypnea
Flexible ribcage → retractions progress: intercostal → subcostal → supraclavicular → tracheal tugging

Croup

Prehospital evidence-based recommendations:
Level A: Nebulized epinephrine for stridor + respiratory distress; **no benefit** from mist therapy
Level C: NIPPV, IM/IV epinephrine
All children receiving nebulized epi → **must be transported**

Bronchiolitis (under 2 years)

AAP guidelines: nasal suctioning + supplemental O_2 for SpO_2 <90%
No proven benefit from albuterol per AAP, but prehospital trial reasonable (document response)
Consider nebulized epinephrine for moderate–severe bronchiolitis

Asthma (≥2 years, most common cause of wheezing)

Albuterol (nebulized or MDI with spacer): **Level A evidence**
Add ipratropium for moderate–severe
IV magnesium for severe
Early steroids
NIPPV for severe
Epinephrine IM/IV: Level C

Pediatric Medication Doses (Key)

Drug	Dose
Albuterol	2.5 mg nebulized or 6 puffs MDI
Ipratropium	0.5 mg nebulized
Methylprednisolone	2 mg/kg IV/IM/IO (max 125 mg)
Dexamethasone	0.6 mg/kg IV/IM (max 16 mg)
Magnesium sulfate	25–50 mg/kg IV (max 2 g)
Epinephrine (anaphylaxis)	0.01 mg/kg of 1:1000 IM (max 0.3 mg)
Dextrose	0.5 g/kg IV (max 25 g)
Glucagon	0.02 mg/kg IM (max 1 mg)
Midazolam	0.2 mg/kg buccal/IN/IM (max 4 mg); 0.1 mg/kg IV
Diazepam	0.1 mg/kg IV (max 4 mg)
Lorazepam	0.1 mg/kg IV (max 4 mg)

Advanced Airway in Children

BVM

Mandatory for all prehospital clinicians: foundation of pediatric airway
Proficiency required; skill retention is low
2019 AHA/ILCOR: BVM reasonable compared to advanced airway in pediatric OHCA

Supraglottic Airways (SGA)

Higher first-pass success than ETI in prehospital
No demonstrated survival benefit in pediatric cardiac arrest
CARES data (2017): BVM associated with **higher survival to discharge** vs. ETI or SGA

Pediatric Prehospital ETI
25–66% first-pass success, 18–50% failure rate, 22–66% complication rate
Highest failure in children **under 2 years**
Field ETI: independent negative predictor of survival in trauma
Seizure patients: 8–19% of field intubations → 45–58% extubated in ED
Bottom line: Risks outweigh benefits for non–critical care paramedic pediatric intubation in most settings

BRUE (Brief Resolved Unexplained Event)

Replaced **ALTE** (Apparent Life-Threatening Event)
Definition: infant <1 year, sudden/brief/resolved episode of: cyanosis/pallor, absent/decreased/irregular breathing, marked change in tone, or altered responsiveness
>80% well-appearing at EMS evaluation; ~all have normal vitals
All BRUE patients should be transported despite apparent resolution
On-scene: examine for occult trauma, check blood glucose
Broad DDx: child abuse found in **up to 11%** of ALTE cases; call to 911 for ALTE associated with **5× higher odds** of abusive head trauma
Refer to medical oversight if caregiver refuses transport

Seizures

10% of pediatric EMS calls
Management protocol (evidence-based 2014 GRADE guidelines):
Immediate benzodiazepine without waiting for IV/IO access
Midazolam: buccal, IN, or IM preferred (0.2 mg/kg, max 4 mg)
After benzodiazepine: check blood glucose (hypoglycemia uncommon in seizure; check post-treatment)
Treat glucose <60 mg/dL with IV dextrose or IM glucagon
Monitor airway/breathing closely: **17% incidence** of respiratory failure during treatment
Hypoglycemic patients → transport even if return to baseline
Febrile seizures: **5%** of population; simple = generalized, <15 min, no focal deficit, ages 6 mo–6 yr; cool with **wet towels** (not ice)

Shock

Never equate shock with hypotension in children: hypotension is a **late, ominous sign**
Key recognition: **tachycardia** + skin signs + altered mental status + weak pulses
Pediatric Hypotension Thresholds by Age

Age	Hypotension Threshold (SBP)
0–28 days	<60 mmHg
1–12 months	<70 mmHg
1–10 years	<70 + (age × 2) mmHg
>10 years	<90 mmHg

Fluid resuscitation: **20 mL/kg** isotonic crystalloid over 5–20 min, push-pull syringe technique
Cardiogenic shock: 5–10 mL/kg boluses
DKA with compensated shock: 10–20 mL/kg over 1 hour
Stop if pulmonary edema develops
Up to 60 mL/kg total may be needed; limit to 40 mL/kg at 1 hour if no intensive care available
Septic shock: IO after **2 failed IV attempts**
Cardiac patients with known mixing lesions: **do not give supplemental O_2 above baseline** (relaxes PVR → worsens shunting → systemic hypoperfusion)

Pediatric Cardiac Arrest

Incidence: 2.6–19.7/100,000 pediatric population/year
Usually end-result of **respiratory failure or shock** (not primary cardiac)
Survival to discharge: 3.3% (infants), 9.1% (1–11 yr), 8.9% (adolescents)
Compression rate: 100–120/min; depth: ~4 cm (infant), ~5 cm (child), 5–6 cm (adolescent)
Bystander CPR: conventional (with rescue breaths) preferred; compression-only if unwilling/unable
Defibrillation:
AED with dose attenuator for **<25 kg (~8 years)**
<1 year: manual preferred; dose-attenuator AED acceptable; regular AED if nothing else available
Manual defibrillation: initial 2–4 J/kg; subsequent shocks 4 J/kg; max 10 J/kg or adult max
Epinephrine: 0.01 mg/kg IV/IO: earlier administration associated with improved outcomes
Amiodarone or lidocaine for shock-refractory VF/pVT

Targeted temperature management: no benefit shown in pediatric arrest (unlike neonatal HIE)
TOR: no model offline pediatric TOR protocol exists; comfort with field TOR is limited among paramedics

Medication Dosing Safety

>30% of pediatric EMS doses reported inaccurate
Use weight estimation tools + pre-printed dosing cards + standardized single-concentration formularies
Medical director oversight of electronic dosing tools essential

PRIORITY PATCH

BVM > SGA > ETI in peds OHCA -- current evidence
Peds ETI: independent **negative** predictor of survival in trauma
Seizure: give benzo first; **then** check glucose (not before)
Febrile seizure cooling: wet towels, **not ice**
Croup + neb epi: **must transport** even if improved

PULSE CHECK

QUESTION 1

The narrowest point of the pediatric airway is located at the:

A. Vocal cords (glottis)
B. Subglottic region
C. Hypopharynx
D. Epiglottis

Answer: B

The pediatric airway is narrowest at the subglottic region (unlike adults where it is narrowest at the cords). Cuffed ETTs are now safe and preferred in children (except neonates) --- the cuff sits below the narrow subglottic segment.

QUESTION 2

Per AAP guidelines, which intervention has NO proven benefit in bronchiolitis?

A. Nasal suctioning
B. Supplemental oxygen for SpO2 <90%
C. Albuterol bronchodilators
D. Positioning to optimize breathing

Answer: C

AAP guidelines: albuterol has no proven benefit in bronchiolitis (caused by RSV, a viral infection). Nasal suctioning and supplemental O2 for SpO2 <90% are evidence-based. A prehospital trial of albuterol with documented response assessment is reasonable.

QUESTION 3

All children receiving nebulized epinephrine for croup must be transported because:

A. Epinephrine may cause rebound worsening after its effects wear off
B. Steroids must be given in the hospital
C. All croup patients require overnight admission
D. Nebulized epi is not approved without physician authorization

Answer: A

All children receiving nebulized epinephrine for croup must be transported due to risk of rebound worsening (rebound croup/stridor) after the epinephrine effect wears off (~2--3 hours). This is a Level A evidence recommendation.

55 Pediatric Trauma Priorities

Epidemiology

#1 cause of death and disability in children/adolescents
1 in 4 children sustains an injury requiring medical care annually
>12,000 children die from trauma/year in U.S.
Top mechanisms: **motor vehicle collision** (highest death rate), falls, firearms (rising in adolescence)
>90% blunt trauma; males predominate

Anatomic/Physiologic Differences

Head

Disproportionately large → leads head-first in falls/decelerations
>80% of multisystem trauma involves head injury; **1/3** of childhood injury deaths from head injury
Even well-appearing children can have significant head injury
Extensive scalp lacerations/subgaleal hematomas in infants → hypovolemic shock
Management: oxygenation, normothermia, normoglycemia, treat seizures, rapid transport

Airway

Cephalad, anterior larynx → need sniffing position + shoulder roll in infants
U-shaped, floppy epiglottis → **Miller blade preferred** for direct laryngoscopy in young children
Narrowest airway at **subglottis** → cuffed ETT safe and preferred (all children except neonates)
Children desaturate **much faster** than adults during intubation attempts

Cervical Spine

Pediatric C-spine injuries uncommon but devastating: worse morbidity/mortality than adults
Under age 8: injuries more likely at **C1–C2** (higher fulcrum, large head, weak neck muscles)
Chance fractures: thoracolumbar compression from lap belt across abdomen → also consider associated hollow viscus injury ("lap belt complex")
Spinal motion restriction: no role in penetrating trauma; not mandatory based on age alone
Padding under **shoulders** required for proper neutral alignment in infants/young children
Minimize backboard time (thin skin → rapid pressure ulcers)

Cardiovascular

Compensate almost entirely by ↑ HR (minimal stroke volume reserve)
Remain normotensive until **Stage III hemorrhagic shock** (30% blood loss)
Tachycardia = most sensitive early indicator of shock

Chest/Abdomen

Elastic ribcage → pulmonary contusion and pneumothorax **without rib fractures**; flail chest is rare
Horizontal ribs + underdeveloped abdominal muscles + thin visceral fat pad → **liver and spleen unprotected**
Diaphragm moves higher on exhalation → isolated chest trauma can injure abdominal organs
"Seatbelt sign" → high suspicion for solid organ, hollow viscus, and thoracolumbar injury

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Classic Exam Case: *Duodenal hematoma from handlebar injury: no external signs, presents later with peritonitis/shock*

Musculoskeletal

Growth plate fractures (epiphyseal-metaphyseal region) rather than ligamentous sprains: ligaments are stronger than growth plates
Waddell's Triad (pedestrian struck): lower extremity fracture + chest/abdominal trauma + head injury

Skin/Temperature

Large surface area-to-body mass ratio → hypothermia risk
Infant heads = major source of heat loss
Cover with blankets/sheets; **cap on infant heads**; turn up heat in ambulance

Resuscitation Priorities

Standard primary/secondary survey (same as adults)
Airway patency + adequate ventilation critical: children at higher risk for bradycardia/hypoxic arrest
Crystalloid for hypotension
IV access: use proximal tibia or distal femur IO if needed

Prehospital tranexamic acid: no current consensus for pediatric trauma

Common Pitfalls

Failure to recognize early shock: any tachycardia without other cause requires investigation
Failure to suspect abdominal/thoracic injury: absence of external signs does NOT rule out internal injury
Gastric dilation from swallowed air → mimics injury, impairs ventilation → consider OG/NG tube

Pain Management

Pediatric pain is **frequently undertreated**
Inadequate analgesia → behavioral abnormalities, PTSD, chronic pain syndromes
Evidence-based options: **morphine 0.1 mg/kg IV** or **fentanyl 0.1 µg/kg IV/IN**, redose at 5 min if needed
Never exceed adult max dose in larger children

Nonaccidental Trauma (NAT)

Up to 1 in 7 children in U.S. experienced abuse/neglect (2018)
~1,770 deaths/year from abuse
1/3 of cases in children under 3 years: head injury and shock in this preverbal age group = suspect NAT
Red flags:
Delay in presentation
Changing or inconsistent history
Mechanism implausible for developmental stage (e.g., 4-month-old "walking")
Multiple occurrences of trauma
Pathognomonic injuries: bite marks, cigarette burns, stocking-glove burns, object-shaped lacerations, injuries to genitals/ear/frenulum
EMS clinicians are **mandatory reporters in all 50 states + DC**
Many states require each interacting medical professional to individually report (not just relay suspicion to ED)

Field Triage (CDC/ACS 2011 Guidelines)

Step 1 (Physiologic): uses modified respiratory rate cutoffs for infants
Step 2 (Anatomic): same criteria as adults
Step 3 (Mechanism): high-risk fall = **>10 feet or 2–3× the child's height**

PRIORITY PATCH

Peds remain normotensive until **30% blood loss** (Stage III) -- hypotension = late sign
Rib fractures NOT required for pulmonary contusion or pneumothorax in children
NAT red flag: mechanism implausible for developmental stage
Waddell's triad: lower extremity Fx + chest/abdominal injury + head injury
EMS clinicians = **mandatory reporters** in all 50 states

⚡PULSE CHECK

QUESTION 1

In children under 8 years, traumatic cervical spine injuries most commonly occur at which level?

A. C5--C7
B. C3--C5
C. C1--C2
D. T1--T2

Answer: C

In children <8 years, C-spine injuries cluster at C1--C2 (higher fulcrum from proportionally large head and weak neck muscles). In older children and adults, injuries cluster at C5--C7. Pediatric C-spine injuries are uncommon but have worse morbidity/mortality than adults.

QUESTION 2

The 'lap belt complex' (Chance fracture) refers to:

A. Lumbar compression fracture from axial load
B. Thoracolumbar flexion-distraction fracture from lap belt, with associated hollow viscus injury
C. Cervical hyperflexion from rear-end collision
D. Sternal fracture with aortic disruption

Answer: B

Chance fracture: thoracolumbar flexion-distraction injury from a lap belt across the abdomen. Always consider associated hollow viscus injury ('lap belt complex'). This occurs with lap belt only (no shoulder strap).

QUESTION 3

Current recommendations for ETT selection in pediatric patients state:

A. Uncuffed ETTs preferred for all children under 8
B. Cuffed ETTs are safe and preferred for all children except neonates
C. Miller blades used only in children over 2 years
D. Prehospital intubation should be avoided in children

Answer: B

Cuffed ETTs are now safe and preferred for all children except neonates --- the cuff sits below the narrowest subglottic point. The Miller (straight) blade is preferred for young children due to the U-shaped floppy epiglottis. Children desaturate much faster than adults.

56 Technology-Dependent Children

Scope

15% of U.S. children have special needs (2013); account for **81.7%** of hospital days at 28 children's hospitals
41% of patients discharged from pediatric tertiary centers relied on some technology
Most common devices: **G/J-tubes** (10%), central venous catheters (7%), medication nebulizers (7%), VP shunts (2%), tracheostomies (1%)
Despite complexity: **BLS is sufficient** for most prehospital encounters with these children

The DOPE Mnemonic (apply to any failing device)

D – Dislodgement
O – Obstruction
P – Pneumothorax (airway), Peritonitis/Perforation/Pseudocyst (G-tubes, VP shunts)
E – Equipment malfunction

Emergency Information Form

Endorsed by AAP and ACEP
Standardized form stored **in the freezer** (easily located)
Contains: diagnoses, medications, allergies, baseline vitals, usual hospital, emergency contacts
Even when parents are home: verify it's up to date

Tracheostomy

Emergencies: dislodgement, obstruction; if on ventilator also consider pneumothorax, vent failure
Equipment needed: suction + catheters, replacement trach (parents often have one), securing ties
If patient in distress:
Attempt BVM via trach first
If ineffective, try BVM via mouth (cover stoma)
Instill a few drops saline before suctioning to loosen secretions
If trach clogged: release ties → deflate balloon → hyperextend head/neck → remove tube → clean or replace
If replacing: lubricate, use obturator or cold water to stiffen tube, insert with posterior/inferior pressure, traction above/below stoma
No replacement available: use trimmed ETT, remove connector, reattach
If can't pass: try smaller size

Ventilators

Transfer to ambulance power supply during transport (bring battery as backup)
Keep home settings unless significant distress, hypoxemia, or high pressures
If any of the above: switch to BVM, use DOPE mnemonic

Home Oxygen

Note home flow rate and FiO_2
Transfer to ambulance O_2 supply for transport; bring personal tanks for return trip

Gastrostomy/Jejunostomy Tubes

Tube tract matures in **6–8 weeks** (PEG): dislodged tube in early weeks is urgent
If tube is in place but obstructed: flush with **5–10 mL carbonated beverage**
If dislodged: inspect stoma (open, no tear), insert replacement G-tube or Foley catheter (lubricated, gentle pressure)
If resistance: try red rubber catheter first, then reattempt with G-tube/Foley
Inflate balloon with 3–5 mL saline → confirm: aspirate gastric contents + air auscultation
Stoma must not be left open if tube recently placed

Other Devices

Device	Key Points
Vagus Nerve Stimulator	Implanted near clavicle; external magnet over device can abort seizure; otherwise provide usual seizure care
Cochlear Implants	Leave in place; ↑ risk of meningitis, mastoiditis, intracranial abscess: consider with fever/neck stiffness
VP Shunt	Drains CSF: ventricle → peritoneum (most common), also ventriculoatrial or pleuroatrial; malfunction or infection → headache, N/V, AMS, focal neuro signs; no prehospital indication to access tubing
Central Venous Catheters	Can use emergently if no IV/IO; prone to bacteremia/sepsis: suspect if fever + tachycardia

PRIORITY PATCH

EIF stored **in the freezer**; AAP/ACEP endorsed; baseline vitals, meds, usual hospital
DOPE for any failing device: **D**islodgement / **O**bstruction / **P**neumothorax or Peritonitis / **E**quipment
Trach emergency: BVM via trach first; if ineffective, cover stoma and BVM via mouth
G-tube obstruction: flush with carbonated beverage; dislodged before 6-8 weeks = urgent; insert Foley as bridge
VP shunt malfunction: HA + N/V + AMS + focal neuro; **no prehospital indication to access tubing**

⚡PULSE CHECK

QUESTION 1

The DOPE mnemonic for failing devices in technology-dependent children stands for:

A. Device, Oxygen, Pulse, Equipment
B. Dislodgement, Obstruction, Pneumothorax/Peritonitis, Equipment malfunction
C. Disconnect, Obstruct, Perfusion, Emergency
D. Depth, Occlusion, Pressure, Electrical

Answer: B

DOPE: D=Dislodgement, O=Obstruction, P=Pneumothorax (airway) or Peritonitis/Perforation/Pseudocyst (G-tube/VP shunt), E=Equipment malfunction. Applies to any failing device in a technology-dependent child.

QUESTION 2

The Emergency Information Form for technology-dependent children is stored where for emergency access?

A. With the child's primary physician
B. On the child's hospital wristband
C. In the freezer
D. Attached to the child's wheelchair

Answer: C

The Emergency Information Form (AAP/ACEP endorsed) is stored in the freezer --- an easily remembered, consistent location EMS can always check. With the caveat that this could vary by region, it is listed in the textbook so could be tested. Contains diagnoses, medications, allergies, baseline vitals, usual hospital, and emergency contacts.

QUESTION 3

Despite the complexity of technology-dependent children, BLS care is sufficient for what percentage of prehospital encounters?

A. 10--20%
B. 30--40%
C. Most encounters
D. Only for BLS-appropriate device types

Answer: C

Despite their complexity, BLS is sufficient for most prehospital encounters with technology-dependent children. These patients account for 81.7% of hospital days at 28 children's hospitals --- EMS familiarity is essential.

57 Approach to the Geriatric Patient

Demographics

Adults ≥65 = **1/3 of EMS call volume**; fastest-growing segment of U.S. population
ED/hospital utilization increased **~25%** over the past decade

Normal Aging Changes

System	Change
Skin	Thinner, less elastic, ↓ subCutaneous fat → skin tears, pressure ulcers rapidly
Temperature regulation	Greater difficulty
Bone	Loss → ↑ fracture risk, ↓ spine flexibility, loss of height
Cardiac/Pulmonary	↓ reserve → impaired compensation for acute illness
Renal	↓ function → ↓ drug clearance
Vision/Hearing	Cataracts, noise-induced hearing loss
Cognitive	Gradual decline in reserve (aging ≠ disease)

Assessment

ABCs unchanged: always start there
Obtain **complete medication list**: prescription + OTC + herbal + supplements; note compliance, recent changes
Environmental assessment: look for clues to disease, fall hazards, pill boxes, pill bottles (empty or full)
Social history: living situation, support network, caregiver capability
Communication pearls:
Always speak to the patient first: do not assume inability to communicate
Clear, strong voice; avoid shouting (distorts words)
Use hearing aids and glasses
Bring assistive devices to ED when practical

Six-Item Screener (Cognitive Impairment)

What year is this?
What month is this?
What day of the week is this?
Recall: apple?
Recall: table?
Recall: penny?
≥3 errors = possible dementia
Sensitivity 89%, specificity 88% (community sample)

PHQ-2 (Depression Screening)

Little interest or pleasure in doing things?
Feeling down, depressed, or hopeless?
Scored 0–3 each; **total >2** = concern for major depressive disorder
Depression ↑ EMS utilization, functional decline, suicide risk

Specific Conditions

Falls
~3 million older adults treated in EDs annually for fall-related injuries
Up to **30%** sustain moderate to severe injuries (fractures, intracranial hemorrhage)
High risk of **under-triage**: even minor-appearing falls can mask major injury
Beta-blockers may mask hemodynamic response; anticoagulants ↑ hemorrhage risk

Polypharmacy & Drug Toxicity
Altered metabolism, distribution, elimination, and excretion with aging
High risk for adverse drug reactions and drug-drug interactions
Anticholinergic and cardiovascular medications especially dangerous

Cognitive impairment → medication errors, unintentional overdose

Delirium (Altered Mental Status)
Reduced ability to focus, fluctuating throughout the day
Common precipitants: pneumonia, UTI, medication toxicity, trauma (especially unwitnessed fall)
Always get **baseline cognitive and neurologic function** before labeling "new confusion"
Broad DDx: unwitnessed fall → TBI until proven otherwise

Cardiac Arrest
~50% of OHCA are elderly; median age 65 (CARES 2019)
Nursing homes: **11%** of OHCA locations (2nd only to private residence)
Morrison's TOR criteria (for BLS and ALS):
Arrest not witnessed by EMS
No AED shock delivered (non-shockable rhythm)
No ROSC in the field
PPV: 99.5% (BLS), 100% (ALS)

Trauma
Age >55 = "Special Consideration" in CDC Field Triage Guidelines → consider trauma center transport (not required)
Older adults are **under-triaged** compared to younger adults with similar injury severity
No age-specific anatomical/physiological triage thresholds exist
Vital signs may appear normal despite major injury (↓ cardiac reserve, beta-blockers masking tachycardia)

Social Issues

Elder abuse: 1 in 6 community-dwelling older adults affected annually (WHO)
Types: financial, psychological, physical, sexual
Risk factors: social isolation, dementia, shared living with abuser
EMS may be mandated reporters (varies by state): each agency should have reporting protocol
Caregiver fatigue: assess caregivers for stress/burnout; report to receiving ED; encourage support resources
Substance abuse: >1 million older adults with substance use disorder; often isolated and underidentified: EMS may be first to recognize

Special Considerations

Padding at upper back for kyphosis; padded backboards to prevent pressure ulcers; minimize backboard time
Integrate with community paramedicine for preventive health roles
For refusals: verify decision-making capacity; involve direct medical oversight; encourage follow-up with PCP
Nursing home patients: insist on records accompanying patient; EMS agencies should proactively coordinate with LTC facilities

PRIORITY PATCH

Older adults = **1/3 of EMS call volume**; fastest-growing U.S. demographic
Suicide rates highest in **older white males >65**; risk factors: recent loss, isolation, cognitive impairment
Falls: beta-blockers mask tachycardia; anticoagulants increase hemorrhage risk; **high under-triage rate**
Age >55 = 'Special Consideration' in CDC Field Triage Guidelines; lean toward trauma center transport
Six-Item Screener: **≥3 errors** = possible dementia (Sn 89%, Sp 88%)

⚡PULSE CHECK

QUESTION 1

Adults ≥65 years account for approximately what proportion of EMS call volume?

A. 1/6 (~17%)
B. 1/4 (~25%)
C. 1/3 (~33%)
D. 1/2 (~50%)

Answer: C

Adults ≥65 account for one-third of EMS call volume and are the fastest-growing segment of the U.S. population. ED and hospital utilization for this group has increased approximately 25% over the past decade.

QUESTION 2

How many errors suggests dementia in the Six-Item Screener for cognitive impairment?

A. ≥1 error
B. ≥2 errors
C. ≥3 errors
D. ≥4 errors

Answer: C

Six-Item Screener: ≥3 errors = possible dementia (sensitivity 89%, specificity 88%). Items: year, month, day of week, and recall of apple, table, and penny. A validated, rapid field cognitive screening tool.

QUESTION 3

When assessing an elderly patient with possible cognitive impairment, which communication approach is most appropriate?

A. Speak to the family member first to obtain accurate history
B. Exaggerate lip movements and touch frequently
C. Always speak to the patient first; do not assume inability to communicate
D. Speak loudly to compensate for hearing loss

Answer: C

Always speak to the patient first --- do not assume inability to communicate. Use a clear, strong voice without shouting (shouting distorts words). Bring hearing aids and glasses to the ED. Use plain language and allow time for responses.

58 Behavioral Health Emergencies

Assessment Framework

Scene safety **first**: cannot enter until safe; collaborate with law enforcement
Rule out organic causes first: hypoglycemia, hypoxia, intoxication, stroke, meningitis — minimum evaluation: glucose, SpO_2, vitals, physical exam for trauma
Field diagnosis usually impossible and irrelevant: treat **symptom patterns**, not specific diagnoses
Minimum evaluation: glucose, SpO_2, vitals, physical exam for trauma

Criteria for Non-Transport (ALL must be met)

Patient has decision-making capacity
Organic etiology reasonably ruled out by field evaluation
No suicidal, homicidal, or aggressive behavior
Known psych history consistent with current symptoms
Adequate social/family/mental health support available

Suicidal Patient

Passive ideation = thoughts without plan; Active ideation = thoughts **with** plan (higher risk)
Gesture = self-harm without expectation of death; Attempt = act with expectation of death
Suicide: **14.5/100,000** in 2017; 10th leading cause of death; **2nd leading cause** ages 10–34
Highest rates: white males >65
Do not hesitate to ask directly about self-harm: questioning does not plant suicidal thoughts
Always transport any patient suspected of suicidal ideation
State laws on involuntary transport vary: know your jurisdiction
High-Risk Factors for Completed Suicide:

Factor	High Risk
Intent	Detailed violent plan, accessible means (gun), prior attempts
Psych Dx	Schizophrenia, bipolar, major depression, acute psychosis
Medical	Terminal illness, chronic disease
Substances	Alcohol, cocaine, other drugs
Social	Widowed/divorced, recent loss, unemployment, isolated
Demographics	Male (more lethal), older, white

Agitated/Violent Patient

Organic causes: hypoglycemia, hypoxia, intoxication, TBI, renal failure
New onset agitation in patient **>45 without psych history** → strongly suspect organic
Violence risk factors: prior violence, psychosis, paranoia, bipolar, antisocial personality disorder
De-escalation (Project BETA Workgroup: 10 Domains):
Respect personal space | Don't be provocative | Establish verbal contact | Be concise/simple
Identify wants and needs | Active listening | Agree or agree to disagree | Set limits
Offer choices and optimism | Debrief patient and staff

Physical Restraint

5-person team: one per limb + one for head
One last chance to cooperate → approach from front and behind → force face-down if lunges → restrain **face-up on stretcher** (one arm above head, one at side)
NEVER prone, "hogtied," or wrapped position → positional asphyxia risk
Lateral recumbent if aspiration concern
Constant monitoring required; never leave unattended; reassess neurovascular status of extremities
Law enforcement should be present; but must not dictate EMS clinical decisions

Chemical Sedation (Medication Summary)

Drug	Dose	Route	Onset	Notes
Haloperidol	5–10 mg	PO/IM/IV	20 min (IM), 5–10 min (IV)	EPS (<10%) → diphenhydramine 50 mg IV or benztropine 2 mg IM
Lorazepam	0.05 mg/kg	IM/IV	15–20 min	Drug of choice for EtOH/benzo withdrawal
Midazolam	0.05–0.1 mg/kg IV; 0.1–0.2 mg/kg IM; 0.2 mg/kg IN (max 10 mg)	IV/IM/IN	5–10 min IV; 15 min IM; 6–8 min IN	Good IM/IN absorption; lower needlestick risk
Ketamine	4–5 mg/kg IM (max 400 mg); 1–2 mg/kg IV	IM/IV	4–5 min IM; <1 min IV	Duration 15–30 min IM; watch for laryngospasm, emergence reactions, intubation rate 12–57%

Excited Delirium Syndrome

Extreme agitation + hyperthermia + psychomotor excitation + superhuman strength
Associated with stimulant use (cocaine, methamphetamine, PCP)
Severe metabolic derangements: lactic acidosis, rhabdomyolysis, hyperthermia
Mortality: **8.3–16.5%**
Manage with verbal de-escalation, medication (midazolam or ketamine preferred for rapid onset)
All suspected cases: transport to ED

PRIORITY PATCH

New agitation in patient **>45 without psych history** → suspect organic until proven otherwise
Never prone, hogtied, or wrapped position → **positional asphyxia**; restrain face-up on stretcher
Benzodiazepines = first-line for **unclear etiology** agitation; ketamine = fastest onset (4-5 min IM)
Ketamine post-agitation intubation rate: **12-57%** in literature; have airway equipment ready
Excited delirium: hyperthermia + extreme agitation + stimulant use; mortality 8-16%; transport all

⚡PULSE CHECK

QUESTION 1

ALL of the following criteria must be met for consideration of non-transport of a behavioral health patient EXCEPT:

A. Patient has decision-making capacity
B. Organic etiology reasonably ruled out
C. Patient has a known psychiatric diagnosis on file
D. Adequate social/family/mental health support available

Answer: C

Non-transport criteria (ALL must be met): decision-making capacity, organic etiology ruled out, no suicidal/homicidal/aggressive behavior, known psychiatric history consistent with current symptoms, adequate support. Having a 'known psychiatric diagnosis on file' is not itself a criterion.

QUESTION 2

Directly asking a patient about suicidal thoughts:

A. Is contraindicated --- may plant suicidal ideas
B. Does not plant suicidal thoughts and is the recommended approach
C. Should only be performed by licensed mental health professionals
D. Should be deferred to the hospital

Answer: B

Directly asking about suicidal ideation does NOT plant thoughts of suicide --- this is a myth. It is the recommended approach. Always transport any patient suspected of suicidal ideation. Suicide is the 10th leading cause of death overall and 2nd in ages 10--34.

QUESTION 3

Which demographic group has the highest rate of completed suicide?

A. Young Black males under 25
B. Adolescent females aged 15--19
C. White males over 65
D. Middle-aged Hispanic males

Answer: C

White males over 65 have the highest completed suicide rates. Overall U.S. rate 14.5/100,000 in 2017. High-risk factors: detailed violent plan, accessible means (firearm), prior attempts, schizophrenia, bipolar disorder, or major depression.

59 Bariatric Patient Challenges

Definitions

BMI (kg/m²)	Classification
<18.5	Underweight
18.5–24.9	Normal
25.0–29.9	Overweight
30.0–34.9	Class I Obesity
35.0–39.9	Class II Obesity
≥40	Class III Obesity

Airway

BMI **>26** = independent predictor of difficult mask ventilation
Two-person technique required for effective BVM in bariatric patients
Ramp position: external auditory canal aligned with sternal notch → improves laryngoscopic view + oxygenation
Achieve with padding under shoulders, neck, head
Class III obesity: 3–4× more likely to have difficult prehospital intubation
Surgical airway: landmarks obscured → use **cuffed ETT** over cuffed tracheostomy tube (better length)
Opioids: these patients do not tolerate apnea → preparation and preoxygenation critical

Breathing

Restrictive physiology: ↑ chest wall mass + ↑ intraabdominal pressure (often ≥12 cmH_2O)
↓ Functional residual capacity, ↓ expiratory reserve, ↓ compliance
↑ O_2 demand, ↓ O_2 reserve → **rapid desaturation**
Position: Fowler's, semi-Fowler's, or reverse Trendelenburg whenever possible
PEEP for CPAP/BiPAP/ventilator: start **~10 cmH_2O**; balance with ↓ preload from high intraabdominal pressure
Tidal volume: **6–8 mL/kg** based on **ideal body weight** (height-based), NOT total body weight
Needle thoracostomy: mean chest wall thickness 4.5 cm in U.S. → standard 4.4 cm needle fails in **~50%**; use **6–6.5 cm catheter**

Circulation

↑ Blood volume, hyperkinetic circulation, myocardial hypertrophy, diastolic dysfunction
BP measurement: appropriate cuff size critical; manual may be more accurate than automatic
CPR: proper positioning and compression depth difficult; mechanical CPR devices may not fit; no definitive evidence of BMI effect on OHCA outcome
Venous access: excess adipose obscures landmarks; longer IV and IO needles needed; IM absorption erratic

Drug Dosing in Obesity

Strategy	Drugs
No weight adjustment	Adenosine, amiodarone, metoprolol, ondansetron, epinephrine, norepinephrine
Ideal body weight (IBW)	Diltiazem, dopamine, ketamine, lidocaine, lorazepam*, midazolam*, morphine, rocuronium, vecuronium
Total body weight (TBW)	Etomidate, fentanyl, propofol, succinylcholine

**Lorazepam and midazolam: bolus by TBW; infusions by IBW*
Drug dosing note: Lipophilic drugs → TBW; Hydrophilic drugs → IBW. Vasopressors titrated to goal MAP.

Bariatric Surgery Complications

Reserved for BMI ≥40 or ≥35 with comorbidities
Short-term: anastomotic/staple leak (Roux-en-Y ~3%), postoperative hemorrhage (~3%, usually within 24 h), infection, DVT, PE
Long-term: small bowel obstruction, dumping syndrome, gastric/bowel ulcers, band erosion or slippage, stricture, cholelithiasis

Movement & Packaging

Standard EMS stretcher: 23 inches wide, supports 550–700 lbs → most patients >400 lbs do not fit safely

Bariatric stretchers: 29 inches wide (expandable to 40"), 850–1600 lb capacity
Minimum **4, ideally 6** personnel for loaded bariatric stretcher
Keep stretcher at **lowest position** to prevent tipping
Bariatric ambulances: ramp or hydraulic lift systems (up to ~1,300 lb)
Standard cervical collars often don't fit → improvise with towels/blankets/manual stabilization
Extra head padding may be needed to maintain neutral alignment (upper back adipose shifts head)
Tourniquets: may require **2 tourniquets** to achieve distal pulse loss in obese extremities

PRIORITY PATCH

>70% of U.S. population overweight; **42.4%** obese: highest-risk patients for airway and procedural complications
Bariatric airway: BMI >26 = independent predictor of difficult mask ventilation → always use **2-person BVM**
Position: Fowler's or semi-Fowler's whenever practical; never supine if avoidable
Tidal volume: **ideal body weight**, not actual; prevents volutrauma
Needle thoracostomy failure ~50% with standard needle in U.S. → use 3.25-inch (8-cm) needle
IO: use **longer bariatric needle**; standard IO needles may not reach cortex

⚡PULSE CHECK

QUESTION 1

Standard 4.4 cm needle thoracostomy fails in approximately what percentage of patients due to chest wall thickness?

A. 10--15%
B. 25--30%
C. About 50%
D. 70--80%

Answer: C

Mean chest wall thickness in the U.S. is 4.5 cm --- standard 4.4 cm needles fail in approximately 50% of patients. Use a 6--6.5 cm catheter in obese patients for needle thoracostomy.

QUESTION 2

Tidal volume for mechanically ventilated bariatric patients should be calculated based on:

A. Total body weight
B. Ideal body weight (height-based)
C. Lean body mass from BMI calculation
D. Adjusted body weight (total + 40% excess)

Answer: B

Tidal volume (6--8 mL/kg) is based on ideal body weight (height-based) --- NOT total body weight. Using total body weight causes dangerous overdistension and barotrauma. PEEP should start approximately 10 cmH2O.

QUESTION 3

The 'ramp position' for bariatric intubation aligns which landmarks?

A. Chin and clavicle horizontally
B. External auditory canal with the sternal notch
C. Nose and navel in a vertical line
D. Mandible and manubrium at 30 degrees

Answer: B

The ramp position aligns the external auditory canal with the sternal notch, improving laryngoscopic view and oxygenation. Achieved with padding under shoulders, neck, and head. Class III obesity (BMI ≥40) increases difficult intubation risk 3--4×.

60 Intimate Partner Violence

Scope

1 in 4 women and 1 in 7 men experience physical violence, sexual violence, or stalking by intimate partner
18.8% of EMS calls may have IPV indicators; 23.4% of IPV patients refuse transport
IPV accounts for at least **1.4 million ED visits/year** in U.S.

Vulnerable Populations

Highest risk: women who are **separated or divorced**, **pregnant** (8–16% of U.S./Canadian pregnant women), racialized individuals, people with disabilities, LGBTQ+ individuals, immigrants
Pregnancy and IPV: increased risk of low birth weight, premature labor: screen **all women of childbearing age >12** regardless of injury appearance

Understanding IPV

The "cycle of violence" (tension → violence → honeymoon) is now considered **oversimplified**
Coercive control: creating threat of negative consequence for noncompliance; may persist without physical violence

Johnson Typology

Type	Description
Situational couple violence	Episodic, context-specific, often bidirectional, less severe
Coercive controlling violence	Unidirectional, escalating, power/control motivated: male perpetrators/female victims most common
Violent resistance	Victim using violence in self-defense against controlling perpetrator
Separation-instigated violence	Nonviolent relationship until separation attempt

EMS Safety on Scene

If IPV suspected at dispatch: request law enforcement secure scene first
On-scene:
Do NOT confront suspected abuser
Do NOT place yourself between arguing couple
Ensure escape route (door) remains accessible
Do NOT let abuser get between you and exit

The 4 Rs Framework

Recognize → Respond → Refer → Record
Recognize: Behavioral cues (withdrawn, scripted speech, anxious), physical findings inconsistent with history (patterned injuries, neck marks, petechiae), partner who answers for patient or prevents private assessment
Respond: Separate from partner; offer same-gender examiner; use open-ended, non-judgmental questions ("I ask all my patients about safety at home"); assure confidentiality; disclose mandatory reporter status where applicable
Refer: Provide resources (24-hour crisis lines, shelters, legal support) without prescribing a course of action — empower, don't direct
Record: Document injuries objectively; use patient's own words in quotes; avoid conclusory language; note time of day and any police badge numbers present

Risk Assessment

70% of women killed by intimate partners had experienced physical IPV prior to death
Separation = significant predictor of homicide (accused aware of impending separation in 21% of cases)
Elevated homicide risk: firearm access, drug use, controlling behaviors, prior weapon threats, prior threats to kill
Danger Assessment tool: 20-item validated measure with 4 danger levels (variable → extreme)

PRIORITY PATCH

IPV screening: **HITS** (Hurt, Insulted, Threatened, Screamed) or **SAFE** (Safety, Afraid, Friends/Family, Emergency Plan)
EMS role: **document injuries, not render a verdict**; avoid accusatory questioning
Danger Assessment tool: 20-item validated measure; **firearm access = strongest homicide predictor**
Separation from partner = highest-risk period; involved in 21% of intimate partner homicides
Mandatory reporting laws vary by state; children in IPV households have significantly increased abuse risk

⚡PULSE CHECK

QUESTION 1

Approximately what percentage of EMS calls may have IPV indicators?

A. 5--7%
B. 10--12%
C. 18.8%
D. 30--35%

Answer: C

18.8% of EMS calls may have IPV indicators in the study cited in the textbook; 23.4% of IPV patients refuse transport. IPV accounts for at least 1.4 million ED visits/year. Highest risk: separated or divorced women, pregnant women (8--16% of pregnant women affected).

QUESTION 2

What is the recommended EMS action if IPV is suspected at dispatch?

A. Confront the suspected abuser and document their denial
B. Request law enforcement to secure the scene first
C. Separate the couple and interview each independently
D. Immediately transport without law enforcement

Answer: B

If IPV is suspected at dispatch, request law enforcement to secure the scene first. On scene: do NOT confront the suspected abuser, do NOT position yourself between an arguing couple, ensure your escape route (door) remains accessible.

QUESTION 3

Johnson's typology characterizes coercive controlling violence as:

A. Episodic, context-specific, bidirectional, less severe
B. Unidirectional, escalating, power/control motivated
C. Victim using violence in self-defense
D. Violence appearing only at separation attempt

Answer: B

Coercive controlling violence: unidirectional, escalating, power/control motivated --- most commonly male perpetrators/female victims. Situational couple violence is episodic, bidirectional, and less severe. The 'cycle of violence' model is now considered oversimplified.

61 Sexual Assault

Scope
Sexual violence affects millions globally; **1 in 5 women, 1 in 71 men** raped in lifetime in U.S.
Rural rates may be as high as 30%
Fewer than **1 in 10** victims report to police
Sexual assault = any sexual activity without consent

Consent
Active, ongoing, voluntary agreement between persons of legal age
Cannot consent: altered by alcohol/drugs, legal incompetency (mental illness, developmental delay, dementia, TBI), when under threat/coercion
Consent can be **withdrawn at any point**: prior consent does not carry forward

Special Populations
Drug-facilitated sexual assault (DFSA): victim incapacitated by alcohol/drugs; document level of consciousness, affect, signs of intoxication
Male sexual assault: more common use of weapons, physical force, multiple assailants; involuntary erection/ejaculation during anal penetration is a physiological reflex: not consent
Transgender/nonbinary: disproportionately high rates (~64%); impaired access to care and stigma compound harm

EMS Approach
Psychological care is universal: even without physical injury, trauma is always present
Restore self-determination: ask before touching, allow patient to make decisions
Non-judgmental; introduce yourself, use patient's preferred name, maintain eye contact, calm tone
It is **NOT your role** to determine if an assault occurred: proceed on the presumption it did
Offer to call a support person

Physical Care
Life-threatening injuries first
Do NOT examine anogenital area unless life-threatening hemorrhage: leave for SANE examiner
Avoid revictimization through unnecessary examination
STI prophylaxis timeline: **HIV prophylaxis within 72 hours**, pregnancy prevention within **120 hours**

Evidence Preservation
DNA evidence: highest quality within **72 hours**; evidence collection possible up to **120 hours**
Do not remove clothing unless medically necessary; if removed → place each item in **separate paper bag** (not plastic: DNA degrades), seal with tamper-resistant tape, label with date/time/description/name
Do not cut through or damage holes/stains in clothing
Protect areas exposed to body fluids; wrap hands in paper (not plastic) if fingernails have evidence
Instruct patient: do not bathe, eat, drink, or use restroom if possible; collect urine/feces if cannot wait
Consider transporting to facility with **SANE (Sexual Assault Nurse Examiner) / SART program**

Documentation & Legal
Assume records will be used in court: accurate, comprehensive, objective, timely
Use victim's exact words in quotes (may be used as "excited utterance" in sentencing)
Document injuries in detail: location, type, size, color, before medical interventions
Chain of custody: document all items collected, sign over to law enforcement or ED
Mandatory reporting laws vary; many jurisdictions require reporting for minors, elderly, disabled

PRIORITY PATCH

DNA collection optimal: **72 hours**; possible up to **120 hours**
HIV prophylaxis: must start within **72 hours**
Pregnancy prevention: within **120 hours**
Do NOT examine anogenital area unless life-threatening hemorrhage; preserve for SANE
Clothing: separate **paper** bags (never plastic; DNA degrades); do not cut through holes or stains

⚡PULSE CHECK

QUESTION 1

What is the EMS provider's role in approaching sexual assault?

A. Gather evidence and assess credibility of the account
B. Proceed on the presumption the assault occurred; determination of facts is not EMS's role
C. Document inconsistencies for law enforcement
D. Genital examination is required before transport

Answer: B

It is NOT EMS's role to determine if an assault occurred --- proceed on the presumption it did. Psychological care is universal even without physical injury. Do NOT examine anogenital area unless life-threatening injury requires it --- preserve forensic evidence.

QUESTION 2

Which population experiences the highest rates of sexual assault with the most impaired access to care?

A. Elderly women in long-term care
B. Transgender and nonbinary individuals (~64%)
C. College-aged women
D. Rural women with limited transportation

Answer: B

Transgender and nonbinary individuals experience disproportionately high rates (~64%), compounded by impaired access to care and systemic stigma. Male sexual assault more commonly involves weapons, physical force, and multiple assailants.

QUESTION 3

A person cannot consent to sexual activity when:

A. Under the influence of caffeine or OTC medications
B. Altered by alcohol/drugs, legally incompetent, or under coercion
C. They have previously consented with the same partner
D. They are in a committed relationship with the person

Answer: B

Cannot consent: when altered by alcohol/drugs, legally incompetent (mental illness, developmental delay, dementia, TBI), or under threat/coercion. Consent can be withdrawn at any point --- prior consent does not carry forward.

62 Child Maltreatment

Scope (2018 Data)

4.3 million referrals → 678,000 confirmed victims
Types: **neglect (60.8%)** > physical abuse (10.7%) > sexual abuse (7%) > emotional/psychological (2.3%)
1,770 children died of abuse or neglect in 2018; rate 2.39/100,000
Most vulnerable: **infants**, preverbal children, children with chronic disease/disabilities

EMS Role

Medical care first: then scene investigation
Unique position to observe home environment, interactions, mechanism-injury consistency
Mandatory reporters in all 50 states + D.C.

Secondary Survey: Red Flags

Bruising

Bruises in **pre-mobile infants** (not yet crawling) are rare and suspicious
Accidental bruising: bony prominences (shins, knees, forehead, hips)
Suspicious locations: upper arms, medial/posterior thighs, torso, cheeks, ears, neck, genitalia, buttocks
Multiple or **patterned** bruises = ↑ concern
Cannot reliably date bruises by color progression (unreliable)

Burns

~10% of pediatric burns are abusive
Most common: immersion scald burns
Red flags: stocking-glove distribution, cigarette burns, symmetrical immersion pattern (sparing of flexor creases)
Document reported mechanism + timing; mismatch with appearance = document and transport

Fractures

11–55% of pediatric fractures are from physical abuse
55–70% of abusive fractures in infants <1 year
Spiral fractures, posterior rib fractures, multiple fractures at different healing stages = high suspicion
EMS cannot radiograph: transport any child with suspicious history

History Taking Approach

Key questions to caregiver:
How/where/when did injury occur?
Who witnessed it?
Does the explanation match the injury and developmental stage?
Long delay in seeking care?
Consistent histories from multiple sources?
Is the child's medical history consistent?
Do NOT challenge or accuse: maintain objectivity; judgmental questioning increases defensiveness

Communication & Documentation

Speak with child alone if possible (verbal children); limit history-taking in front of caregiver
Use open-ended questions; let child speak freely
Quote all child and caregiver statements verbatim
Document scene findings; note consistency or inconsistency with reported mechanism
Communicate all concerns to receiving hospital team

Mimics of Child Abuse

Mongolian spots (congenital melanosis): purple-gray, lower back/buttocks, present since birth
Hemophilia/bleeding disorders
Cultural practices: coining, cupping, moxibustion → distinctive skin markings

Sexual Abuse

Rare for acute sexual abuse to present requiring EMS (most disclosed weeks–years later)
Call may be caregiver not knowing what else to do or lacking transportation

Do NOT conduct detailed interview: brief comfort/pain assessment only; leave investigation to specialists
If child spontaneously discloses: allow it, **document verbatim in quotes**
Evidence: protect clothing, diapers, bedding in separate paper bags; transfer to law enforcement or hospital
Transport to facility with multidisciplinary resources

IPV and Child Maltreatment

Children in homes with IPV = **significantly increased** risk of maltreatment and emotional harm
Always consider child safety when responding to IPV calls

PRIORITY PATCH

Most common type: **neglect (60.8%)**; physical abuse is 10.7%
Any bruise in a **pre-mobile infant** is suspicious; cannot reliably date bruises by color
Suspicious burns: stocking-glove, cigarette, symmetrical immersion with spared flexor creases
High-risk fractures: posterior rib, multiple healing stages, metaphyseal corner fractures in infants
EMS are **mandatory reporters in all 50 states + D.C.**; document verbatim; do not accuse

PULSE CHECK

QUESTION 1

Which bruising pattern in a child is most suspicious for physical abuse?

A. Bruises to the shins of a child learning to walk
B. Multiple bruises of varying ages on the torso, cheeks, and ears of a 4-month-old
C. Single forehead contusion after a fall from a chair
D. Bruising over the iliac crest in a hockey-playing child

Answer: B

Bruises in pre-mobile infants are rare and suspicious. Suspicious locations: torso, cheeks, ears, neck, genitalia, upper arms, medial/posterior thighs. Accidental bruises occur over bony prominences (shins, knees, forehead). Bruises cannot be reliably dated by color.

QUESTION 2

Classic features of abusive immersion scald burns include:

A. Irregular burn borders with splash marks
B. Burns limited to one extremity only
C. Stocking-glove distribution sparing the flexor creases
D. Burns limited to the palm of one hand

Answer: C

Immersion scald burns in abuse: stocking-glove distribution with uniform depth/margin lines from forced immersion, sparing flexor creases. Other red flags: cigarette burns, symmetrical immersion pattern, mismatch between reported mechanism and appearance.

QUESTION 3

EMS providers are mandatory reporters of suspected child abuse in:

A. Only states with specific EMS mandatory reporter laws
B. All 50 states and Washington D.C.
C. States where EMS providers have completed formal child abuse training
D. Federally regulated systems only

Answer: B

EMS providers are mandatory reporters in all 50 states and Washington D.C. Reporting is required when abuse is suspected --- EMS does not need to confirm it. Scene observations (home environment, caregiver interactions) are uniquely accessible to EMS.

63 Human Trafficking

Scope

>24.9 million forced labor victims + **>15.4 million** sexual exploitation victims globally
$150 billion/year global industry
34.7% of sex trafficking victims in U.S. are U.S. citizens
Up to **87%** of trafficking victims report being seen by a medical professional within a year of identification

Definition (Trafficking Victims Protection Act 2000)

"*...the recruitment, harboring, transportation, provision, or obtaining of a person for labor or services, through force, fraud, or coercion for involuntary servitude, peonage, debt bondage, or slavery OR sex trafficking induced by force, fraud, or coercion, OR any commercial sex act where the person is under 18 years of age*"

Action–Means–Purpose (A-M-P) Model

Adults: need one element from each category
Actions: recruit, harbor, transport, provide, obtain
Means: force, fraud, or coercion
Purpose: commercial sex OR labor/services
Minors under 18: ANY commercial sexual activity = human trafficking (no need for force/fraud/coercion)

Common Myths

Myth	Reality
Always involves dramatic kidnapping	Most recruitment uses promises/relationships, not force
All commercial sex is trafficking	Only if victim is <18, OR if force/fraud/coercion is used
Only foreign nationals are trafficked	34.7% of U.S. sex trafficking victims are U.S. citizens
Trafficking requires crossing borders	No transportation requirement
Victims can't leave	Trauma bonding, fear, lack of self-identification as victims
All traffickers are men	Female traffickers exist; family members are common perpetrators

Risk Factors for Victimization

Adolescent youth (average entry age **12–15 years** for commercial sex)
LGBTQ+ (especially transgender youth)
Runaways/homeless youth: **40%+** approached by pimp within 24–48 hours
History of childhood sexual abuse (**80–90%** of trafficked youth)
Poverty, food/housing insecurity, dependents, low literacy
Disabilities, rural populations, Native American populations, migrant workers

Environmental (Scene) Red Flags

Indicator	Significance
Any minor <18 in commercial sex	Sufficient alone: meets definition of trafficking
High-security measures (boarded/opaque windows, outside door locks, cameras)	Confinement indicators
Patient not free to come and go	Lack of autonomy
Large numbers of occupants, living and working on-site	Controlled environment
Older male present who is not legal guardian	Potential controller
Third party insists on being present/translating	Isolation tactic
Large amounts of cash, sex paraphernalia	Commercial sex environment
Patient lacks identification documents	Document control: common trafficking tactic

Individual (Patient) Red Flags

Appears malnourished or fearful of authority figures
Inconsistent or "scripted" history

Withdrawal, flat affect, dissociation
No knowledge of current city or how long they've been there
Talks about older boyfriend or sex with older man
Claims to be older but looks younger
Brands/tattoos (neck, axilla, thigh, groin, lower back, inside mouth): crowns, names, "property of," currency symbols, barcodes
Multiple STIs, multiple pregnancies/abortions, vaginal/anogenital trauma, fistulas

EMS Approach: Trauma-Informed Care

The "4 Rs" Framework (SAMHSA):
Realize widespread effects of trauma and paths to recovery
Recognize signs/symptoms of trauma
Respond by integrating trauma-informed knowledge into practice
Resist retraumatization
Do NOT:
Attempt to "rescue" the patient (respect autonomy)
Confront or antagonize suspected trafficker
Alert victim to suspicions (safety concern)
Use terms like "prostitute," "pimp," "perpetrator"
Pressure for disclosure in presence of suspected trafficker
DO:
Focus on immediate medical needs first
Attempt to interview/transport patient alone ("agency policy: only patient rides in back")
Use caring, non-judgmental, patient approach
Ask sensitive questions: "Does your family live with you?" / "Has someone made you feel unsafe?"
Offer hotline information discreetly for possible later use

Destination & Disposition

Follow general transport guidelines; for sexual assault consider SANE availability
Adult victims retain autonomy and right to refuse
Pediatric patients: consult child protective services for disposition
Law enforcement: involve only if patient requests, law requires, or imminent safety threat

Documentation & Reporting

Meticulous documentation: history, physical, inconsistencies, environmental indicators
All quotes verbatim
Communicate all concerns at handoff
National Human Trafficking Hotline: 1-888-373-7888 (text: 233733): 24/7, 170+ languages
Child sex trafficking also reportable to **NCMEC**: 1-800-THE-LOST or CyberTipline.org
Mandatory reporting varies by state: know your jurisdiction; penalties for failure to report in some states

Medical Director Responsibilities

Education/training for EMS clinicians (recognition, trauma-informed care, documentation, reporting)
Protocols referencing state laws, especially for child sex trafficking
Establish relationships with law enforcement task forces and social services
Consider screening tools and field reference cards (Blue Campaign materials)

PRIORITY PATCH

Minor in ANY commercial sex act = trafficking; no force/fraud/coercion required
Average entry age into commercial sex trafficking: **12-15 years**
Third party insisting on translating = **red flag**; get patient alone ('agency policy: patient in back alone')
Tattoos/brands: neck, thigh, groin, inside mouth; names, 'property of,' barcodes, currency symbols
National Trafficking Hotline: **1-888-373-7888**; text 233733; 24/7, 170+ languages

⚡PULSE CHECK

QUESTION 1

Under the TVPA, a 16-year-old in commercial sex acts requires which additional elements to constitute human trafficking?

A. Evidence of force, fraud, or coercion
B. Evidence of transportation across state lines
C. No additional elements --- any commercial sex act by a minor is trafficking
D. A documented labor or servitude arrangement

Answer: C

Under the TVPA, ANY commercial sex act involving a person under 18 constitutes human trafficking --- no force, fraud, or coercion required. For adults, all three AMP elements must be proven. This legal distinction is critical.

QUESTION 2

The Action-Means-Purpose (AMP) Model for adult trafficking requires:

A. One element from any category
B. One element from each of the three categories
C. All three elements from the 'Actions' category
D. Proof of financial compensation

Answer: B

Adult trafficking: one element from each category required --- Actions (recruit/harbor/transport/provide/obtain) + Means (force/fraud/coercion) + Purpose (commercial sex OR labor/services). For minors in commercial sex: ANY action = trafficking.

QUESTION 3

What percentage of U.S. sex trafficking victims are U.S. citizens?

A. 10--15%
B. 25--30%
C. 34.7%
D. 50%

Answer: C

34.7% of sex trafficking victims in the U.S. are U.S. citizens. The myth that trafficking only affects foreign nationals is FALSE. Up to 87% of victims report being seen by a medical professional within a year of identification --- EMS encounters matter.

64 Ethical Challenges

Core Principles of Medical Ethics

Autonomy: right to self-determination, including decisions that cause harm to self
Beneficence: acting in patient's best interest
Non-maleficence: do no harm
Justice: fair treatment regardless of age, race, sex, socioeconomic status
Law establishes minimum standards — it does not mandate the highest ethical standard.

Refusal of Care: Decision-Making Capacity (5 Criteria)

Patient has **sufficient information** about their condition
Patient **understands risks and benefits** of options (including no action)
Patient can **use information to make a decision** consistent with personal values
Patient can **communicate their choice**
Patient is **free from undue influence** (family, friends, etc.)
Capacity = clinical determination by EMS provider
Competence = legal determination (by judge)
Conditions impairing capacity: hypoglycemia, head trauma, severe psychiatric illness, sepsis, intoxication
Treating without consent in a patient with capacity → liability for **battery**
Not treating a patient without capacity who then suffers harm → liability for **negligence**
Document: all information communicated, patient's demonstrated understanding, why capacity was or was not present

Triage Decisions

Prudent layperson standard: an emergent condition is what a reasonable layperson (without medical training) would believe is an emergency
EMS clinicians should **not dissuade patients from seeking transport**: they lack diagnostic tools to rule out serious conditions
An **EMS physician on scene** may be able to evaluate and discharge a patient
Mass casualty: EMS physician may screen and clear patients at scene to prevent unnecessary transport

Termination of Resuscitation (NAEMSP Criteria: Medical Arrest)

Arrest **not witnessed by EMS**
No shockable rhythm identified by AED or monitor
No ROSC prior to EMS transport
Always apply free of bias (age, sex, race, socioeconomic status)
Local protocols may specify minimum CPR duration before TOR
Active physician oversight required; provide grief support and field guidance for family

Confidentiality & HIPAA

EMS subject to HIPAA: confidentiality is the rule
Permitted exceptions for disclosure: criminal investigations, suicidal/homicidal patients, suspected child/elder abuse, public health threat, crime in emergency
Social media: **never share** patient or clinical case photos/videos, even "de-identified"

Error Disclosure (Truth-Telling)

Patients **want** to know about errors (even minor ones)
Disclosure supports autonomy, informed decision-making, patient safety
Most malpractice suits filed because of perceived absence of, or inadequate, disclosure
Organizations with robust disclosure programs report favorable outcomes in claims filed and litigation costs
Most states: apologies are **inadmissible** as statements of fault
Elements of good disclosure: facts, steps taken, plans to prevent recurrence, sincere apology

Personal Risk

No moral requirement for health care professionals to submit to **significant** self-endangerment
Use reasonable judgment: await law enforcement when scene is unsafe
Appropriate PPE before patient contact when infectious risk exists

Training & Research

Practicing procedures on recently deceased: **consent from family required**

Research using exception from informed consent (EFIC): FDA + HHS regulations; community consultation mandatory; data monitoring + IRB oversight required; obtain consent from patient/next of kin as soon as possible

Treatment of Minors

Standard: **parental/guardian consent** required
Emancipated minor (state-specific): married, legally separated from parents, pregnant or has a child, armed forces → can consent and refuse
Mature minor (usually >14): may provide limited consent; preferable to involve parents
Emergency exception: life-threatening illness/injury without parent present → treat and transport
Protective custody: last resort; consult medical oversight + law enforcement; parents retain some rights even after custody taken

PRIORITY PATCH

Capacity = clinical determination (EMS); **Competence** = legal determination (judge)
Treating without consent in patient with capacity = **battery**; not treating a patient without capacity = **negligence**
NAEMSP TOR criteria (medical arrest): not witnessed by EMS + no shockable rhythm + no ROSC
EFIC research: community consultation mandatory; obtain consent from patient or next-of-kin ASAP
Practicing procedures on recently deceased: **family consent required**

⚡PULSE CHECK

QUESTION 1

Which best distinguishes 'capacity' from 'competence' in a refusal of care situation?

A. They are interchangeable terms
B. Capacity is a clinical determination by EMS; competence is a legal determination by a judge
C. Competence is assessed by EMS; capacity by an ED physician
D. Capacity applies only to adults

Answer: B

Capacity = clinical determination (by EMS). Competence = legal determination (by a judge). Treating a patient with capacity without consent = liability for battery. Not treating a patient without capacity who suffers harm = liability for negligence.

QUESTION 2

Which of the following is NOT one of the five criteria for decision-making capacity?

A. Patient has sufficient information about their condition
B. Patient can communicate their choice
C. Patient is accompanied by a family member or guardian
D. Patient is free from undue influence

Answer: C

The five capacity criteria: (1) sufficient information, (2) understands risks/benefits, (3) can apply information consistently with personal values, (4) can communicate choice, (5) free from undue influence. Family presence is NOT a required criterion.

QUESTION 3

The 'prudent layperson standard' defines an emergency as:

A. What an EMS physician would consider a medical emergency
B. What a reasonable layperson without medical training would believe is an emergency
C. Any condition with abnormal vital signs
D. Only conditions listed in the EMS protocol as emergencies

Answer: B

The prudent layperson standard: an emergency is what a reasonable layperson (without medical training) would believe is one. EMS clinicians should not dissuade patients from transport --- they lack diagnostic tools to rule out serious pathology.

65 Death, Dying, and End-of-Life Issues

Epidemiology

~360,000 out-of-hospital cardiac arrests/year in U.S.; 60% treated by EMS
~10% of cardiac arrest calls may be for terminally ill patients; >60% had verbal/written DNAR requests

Ethical Foundation

Respect autonomy → honor patient preferences expressed in advance documents or through surrogates

Advance Directives

Document	Who Completes	When Applicable	Can EMS Execute?
Advance Directive (Living Will)	Patient	Future scenarios (theoretical)	Usually not directly
POLST/MOLST/POST	Health professional (after patient discussion)	Current time, present illness	**Yes**
DNAR	Health professional	Pulseless + apneic patient only	**Yes**

Living wills: theoretically worded, difficult to apply to specific field scenarios; useful for identifying surrogate
Durable power of attorney for health care: designates surrogate → surrogate decisions may be followed with immunity if acting in good faith
All 50 states now have some form of out-of-hospital DNAR authorization (as of 2020)

POLST (Physician Orders for Life-Sustaining Treatment)

Developed in Oregon 1991; now active or in development in all 50 states
Actionable medical orders signed by licensed health professional → immediately executable by EMS
Section 1: CPR orders (required to be valid in many states): applies ONLY when patient is pulseless/apneic
Section 2: Level of medical interventions: guides care when patient is **NOT** in arrest
Common misconceptions:
Comfort care ≠ "don't treat": comfort measures are always appropriate
Having a POLST does not mean limiting care: **52.1%** of ED patients with POLST wanted full treatment
Patients with limits on care can still be transported if needed for symptom management
POLST registries: available in ~half of states; Oregon registry received >500,000 forms; EMS can query
National POLST Form (2019): accepted across states

DNAR Orders

Only apply when patient is **pulseless and apneic**: does NOT mean "do not treat" in all other situations
Variability in honoring: in one study, resuscitation attempted 21% of the time despite DNAR
Some EMS systems permit verbal requests from family to withhold resuscitation (with protocols)

Hospice & Palliative Care

Palliative care: symptom management + quality of life improvement, compatible with any treatment intensity
Hospice: palliative care specifically for terminally ill patients with **<6 months** prognosis
Medicare Hospice Benefit: per diem covers all hospice-eligible condition care
If hospitalized, hospice must authorize or patient disenrolls
Hospice families call 911 because: don't understand hospice goals, fear, symptom crisis (pain, dyspnea, agitation, nausea)
First action: **call the hospice agency**
EMS cannot take orders from hospice nurse in most jurisdictions → symptom management through protocols or direct medical oversight
Common End-of-Life Symptom Management (field):

Symptom	First-Line Approach
Pain	Concentrated liquid morphine 5–10 mg PO/SL q30 min (opioid-naive); consider IV access
Dyspnea	Supplemental O_2, then morphine 5 mg PO/SL q30 min (lower dose than pain); fan near patient
Agitation	Non-pharmacologic first; haloperidol 0.5–1 mg PO/IV q1h; lorazepam 0.5–1 mg PO/IV q1h (second-line)
Nausea	Haloperidol 0.5–1 mg PO/IV q1h

Care for Grieving Survivors

Death of patient ≠ end of EMS responsibility: **survivors become patients**
Bereaved spouses have ↑ risk of death
Most families find EMS **accepting of field death and non-transport**: communicate compassionately
Common complaint: questions left unanswered
EMS providers find death notification stressful: education and structured tools (e.g., **GRIEV_ING** model) improve confidence and competence
Difficult notifications (child, violence, suicide): offer additional training to EMS teams

Pandemic/Disaster Considerations

Pre-event collaboration with public health, hospitals, and dispatch to develop surge protocols
Goals of care confirmation critical when hospital access may mean dying without family
Limiting care decisions: made through **state/public health guidelines**: not by individual EMS clinicians alone

PRIORITY PATCH

Living will: patient-authored; theoretical scenarios; usually not directly executable by EMS
POLST/MOLST: signed by health professional; **immediately executable by EMS**; Section 1 (CPR) applies only when pulseless/apneic
DNAR: only applies when pulseless AND apneic; does NOT mean 'do not treat' in all situations
52.1% of patients with POLST wanted **full treatment**; having one does not mean limiting care
Hospice call: **call the hospice agency first**; EMS cannot take orders from hospice nurse in most jurisdictions

⚡PULSE CHECK

QUESTION 1

Which advance directive is immediately executable by EMS for pulseless/apneic patients?

A. Living will / advance directive
B. Durable power of attorney for health care
C. POLST/MOLST
D. Verbal family report of patient's wishes

Answer: C

POLST (Physician Orders for Life-Sustaining Treatment) = actionable medical orders signed by a licensed health professional, immediately executable by EMS. POLST Section 1 (CPR orders) applies ONLY when the patient is pulseless/apneic. Living wills are theoretical and difficult to apply in specific field scenarios.

QUESTION 2

POLST was originally developed in 1991 in which state?

A. California
B. New York
C. Oregon
D. Washington

Answer: C

POLST was developed in Oregon in 1991 and has since been adopted (active or in development) in all 50 states. As of 2020, all 50 states have some form of out-of-hospital DNAR authorization.

QUESTION 3

'Comfort care' in the context of a POLST order means:

A. Withhold all interventions
B. Active comfort measures and symptom management --- NOT 'do not treat'
C. Requires physician presence before implementation
D. Applies regardless of whether patient is in cardiac arrest

Answer: B

Comfort care ≠ 'don't treat.' Comfort measures (pain control, positioning, O2, anti-nausea) are active treatments minimizing suffering. POLST Section 1 applies ONLY when pulseless/apneic. Section 2 guides care when patient is NOT in arrest.

66 Family and Bystanders

Family in Patient Care

EMS threshold for access is **lower** than other medical professionals → de facto safety net
Principles of family-centered care:
Acknowledge family's strengths, resources, and needs
Partnership between patient, family, and clinicians
Family members as valuable collateral informants: but filter and verify
Patients retain **autonomy and confidentiality** even with family present
Family member ≠ automatic access to patient's medical information
Adolescents may not disclose drug/alcohol use or sexual history in front of parents

Cultural Competency

Culture shapes health beliefs, sick role, and attitudes toward health care professionals. Providers must keep this in mind to offer thoughtful, patient-centered care.
Specific cultural expectations around decision-making, disclosure, gender, and family roles vary widely — ask rather than assume
When language barriers exist, use professional interpreters; third-party translation by a family member or bystander may distort history and create privacy concerns

Social Isolation

Defined as disengagement from social ties, institutional connections, or community participation
Perceived social isolation (loneliness) more predictive of poor health than objective isolation
Social isolation: mortality risk ratio comparable to traditional clinical risk factors
Isolation risk factors: advanced age, frailty, disability, mental illness, poverty, language barrier
EMS tools: Berkman-Syme Social Network Index, UCLA Loneliness Scale
EMS providers: identify isolation cues, report to ED, refer to community resources (211 system)

Bystanders

Bystander effect: presence of others ↓ individual likelihood of intervention
Exception: more likely to help if larger group of male strangers, perceive high cost to non-intervention
Bystander roles: CPR, history witness, locating people who left scene, providing information
Manage with mutual respect; one EMS member can manage bystander questions while others care for patient
Consider privacy when providing care in public settings

Physician Bystanders

Most physicians unfamiliar with EMS protocols and capabilities
EMS personnel often intimidated by on-scene physicians
Use a formal process (e.g., on-scene physician form):
Physician must show credentials
Must accompany patient to hospital
Must sign all orders on PCR
Assumes all medicolegal responsibility until patient transferred to hospital physician
Medical director should prepare protocols and guidance for this scenario

Violence Against EMS

2,000 EMS workers injured in violence/assaults annually (CDC)
65% report having experienced workplace violence
Increasing bystander violence against EMS (not just patients)
Warm zone operations: EMS trained to enter with law enforcement entry team for active shooter/mass casualty events
Medical director role: coordinate with law enforcement for joint training; develop protocols for dangerous scene operations

PRIORITY PATCH

Family member ≠ automatic access to patient's medical info; patient retains autonomy even with family present
Physician bystander: must show credentials, accompany patient to hospital, **sign all orders on PCR**, assumes medicolegal responsibility
Bystander effect: more likely to intervene if male strangers who perceive high cost to non-intervention
Social isolation mortality risk is comparable to traditional clinical risk factors
2,000 EMS workers injured in assaults annually (CDC); 65% have experienced workplace violence

⚡PULSE CHECK

QUESTION 1

Which approach is recommended when a language barrier exists when taking a history?

A. Have a family member translate to save time
B. Use professional interpreters; third-party translation may distort history and create privacy concerns
C. Rely on gestures and vital signs rather than attempting history
D. Defer all history-gathering to the receiving hospital

Answer: B

Use professional interpreters --- third-party translation by family or bystanders may distort history, create privacy concerns, and introduce bias. Culture shapes health beliefs and attitudes toward health care professionals --- ask rather than assume.

QUESTION 2

Perceived social isolation (loneliness) in elderly patients has a mortality risk comparable to:

A. Mild COPD exacerbations
B. Traditional clinical risk factors (smoking, obesity, hypertension)
C. Minor electrolyte abnormalities
D. Single-episode syncope without cardiac etiology

Answer: B

Perceived social isolation has a mortality risk ratio comparable to traditional clinical risk factors. Loneliness (subjective) is more predictive of poor health outcomes than objective isolation. Risk factors: advanced age, frailty, disability, mental illness, poverty, language barriers.

QUESTION 3

Patients retain which rights even when family members are present?

A. Family members automatically have access to patient medical information
B. Patient autonomy and confidentiality are maintained even with family present
C. Parents always have unlimited access to adult children's medical information
D. EMS must obtain family consent before treating adults

Answer: B

Patients retain autonomy and confidentiality even with family present. Family member ≠ automatic access to medical information. Adolescents may not disclose drug/alcohol use or sexual history in front of parents --- private assessment opportunities matter.

67 Analgesia

The Problem: Oligoanalgesia

20% of ~15 million annually transported EMS patients experience moderate-to-severe pain
Oligoanalgesia (inadequate pain relief) is common: historically only ~18% of extremity fracture patients received prehospital analgesia
Pediatric patients especially under-treated
NAEMSP position: "*Relief of pain and suffering must be a priority for every EMS system*"

What Protocols Should Address

Mandate for pain assessment
Pain measurement tools
Indications/contraindications
Nonpharmacological interventions
Pharmacological options
Monitoring and documentation before/after analgesia
Transfer of information to receiving facility

Pain Assessment Tools

Numeric Rating Scale (NRS): 0–10, verbal: easiest for most patients
Visual Analogue Scale (VAS): 100-mm line: useful for non-English speakers (print in patient's language)
Verbal Rating Scale: 5-level scale
Wong-Baker FACES: cartoon faces: for pediatric patients and non-English speakers
Color Analogue Scale: color intensity indicates pain: pediatric use
FLACC: observational, for non-verbal/preverbal children
Vitals and facial expressions: **unreliable** for objective pain assessment: do not substitute for validated scales

Common Myths (and Reality)

"Pain meds will mask the diagnosis" → FALSE; effective analgesia does not obscure diagnosis
"Uniform dose = uniform response" → FALSE; significant inter-patient variability; titrate to effect
"Patient doesn't look like they're in pain" → FALSE; pain cannot be gauged by vital signs or expressions
Distraction for procedures: describing each step magnifies pain: distract instead

Pharmacological Options

Opioids (Desired properties: rapid onset, efficacy, titratable, reversible)

Drug	Route	Key Features
Fentanyl	IV/IM/IN	Lipid-soluble, peak effect in minutes, half-life <60 min, no histamine release, no cardiac contractility effect, safe across ages; preferred prehospital opioid
Morphine	IV/IM/SQ	Widely used; decreases preload/afterload; caution in hemodynamic instability; histamine release possible; slower onset than fentanyl via IM/SQ

Opioid antagonist (naloxone) available for reversal
Fentanyl (Kanowitz study): avg 118 µg titrated, minimal adverse events

Ketamine

Dissociative anesthetic (structurally related to PCP)
Preserves airway reflexes, bronchodilator, no respiratory depression
Use: procedural pain, field amputations, extrications, agitation (higher doses)
Analgesic dosing: sub-dissociative 0.1–0.3 mg/kg IV (adjunct to opioids)
Sedation/agitation: 4–5 mg/kg IM; 1–2 mg/kg IV
Combination ketamine + opioid: better pain control in first 15 min, but not at 1 hour
Side effects: dissociative effects, emergence reactions, laryngospasm, hypersalivation
Intubation post-ketamine: estimated 12–57% in agitation literature

Nitrous Oxide

Self-administered 50% nitrous oxide–oxygen mixture
Safe, effective (85% pain relief in rural EMS study), rapid onset/offset
Minimal side effects (mainly nausea)
Safe for clinicians in moving vehicle (short-term exposure with ventilation)
FADDY systematic review: "effective and safe form of analgesia"

NSAIDs
Particularly useful for **ureteral colic** and musculoskeletal pain
Additive with opioids
Avoid if: known NSAID allergy, platelet inhibition concern (intracranial/internal hemorrhage), GI bleed risk

IV Acetaminophen
Increasing prehospital use; similar efficacy to IV opioids at 60 min; no significant advantage in time to analgesia
Single dose: very low risk of hepatic toxicity

Nonpharmacological Interventions

Therapeutic communication: language choice has physiological effect
Example: "Let your mind go to your favorite place..." → distraction/guided imagery
Say "intense heat" not "bee sting" for IV starts
"I can get you through this" for children
Distraction: music, conversation; do not narrate each step of painful procedure
Splinting, positioning, ice (where appropriate)

Barriers to Prehospital Analgesia

Lack of training, concern about "masking diagnosis," concern about side effects
Cumbersome protocols requiring base hospital contact
Pediatric: unfamiliarity, difficulty assessing pain, uncooperative patients
Addressing barriers (especially education) = significant improvements in prehospital pain treatment

PRIORITY PATCH

Historically ~18% of extremity fracture patients received prehospital analgesia; **oligoanalgesia is common**
Fentanyl: preferred prehospital opioid; lipid-soluble, no histamine release, no cardiac depression
Ketamine analgesic dose: **0.1-0.3 mg/kg IV** (sub-dissociative); sedation: 4-5 mg/kg IM or 1-2 mg/kg IV
Vitals and facial expressions are **unreliable** for pain; use validated scales (NRS, FACES, FLACC)
'Pain meds mask diagnosis' = FALSE; effective analgesia does not obscure surgical diagnosis

⚡PULSE CHECK

QUESTION 1

The NAEMSP position statement on prehospital analgesia states:

A. Analgesics should be withheld until a diagnosis is established
B. Relief of pain and suffering must be a priority for every EMS system
C. Opioids should be avoided prehospitally due to respiratory depression risk
D. Pain management is protocol-optional at each agency's discretion

Answer: B

NAEMSP: 'Relief of pain and suffering must be a priority for every EMS system.' Only ~18% of extremity fracture patients historically received prehospital analgesia --- demonstrating the oligoanalgesia problem. Effective analgesia does NOT mask the surgical diagnosis.

QUESTION 2

The Wong-Baker FACES pain scale is most appropriate for:

A. Adult patients who speak English
B. Pediatric patients and non-English speakers
C. Elderly patients with dementia
D. Patients with altered mental status

Answer: B

Wong-Baker FACES (cartoon faces) is designed for pediatric patients and non-English speakers. Numeric Rating Scale (0--10 verbal) is easiest for most adults. FLACC is used for non-verbal/preverbal children. Vital signs and facial expressions are unreliable substitutes for validated scales.

QUESTION 3

Which myth about prehospital analgesia is FALSE?

A. Effective pain relief does not obscure the surgical diagnosis
B. Pain medications will mask the diagnosis if given prehospitally
C. Significant inter-patient variability in analgesic response requires titration
D. Pediatric patients are frequently undertreated for pain

Answer: B

FALSE: 'Pain meds mask the diagnosis.' Effective analgesia does NOT obscure the surgical diagnosis --- this is a well-documented myth. Uniform doses do NOT produce uniform responses (inter-patient variability). Pain assessment must use validated scales, not provider impressions.

68 Point-of-Care Testing in EMS

What is POC Testing?

Testing at the patient's side with near-immediate results
Classic EMS example: **fingerstick blood glucose**
Potential benefits: earlier treatment, informed destination decisions, ↓ ED length of stay

Three Core Questions Before Implementation

Is the test **valid and reliable** in prehospital conditions?
Will it **change clinical action** and does the system allow response to results?
Is it within **EMS scope, education, and infrastructure**?

Regulatory Framework (U.S.)

FDA regulates medical devices under **Clinical Laboratory Improvement Amendments (CLIA)**
CLIA Laboratory Categories and EMS Applications

CLIA Category	Examples	EMS Use
CLIA-Waived	Blood glucose, urine pregnancy, urinalysis, fecal occult blood, POC lactate (Lactate Pro devices)	Can use without accreditation
CLIA-Moderate Complexity	~70% of POC tests (INR, troponin, basic metabolic panel)	Requires lab director oversight, technical consultant, training documentation, quality controls
CLIA-High Complexity	Advanced lab tests	NOT feasible for EMS (regulatory barriers)

EMS personnel: minimum high school diploma + documented satisfactory training
All POC use requires physician orders (protocol) and CQI infrastructure

Specific Tests

Test	Clinical Use	Key Points
Blood Glucose	Standard of care	CLIA-waived; universal EMS application
Capnography	Tube placement, ventilation titration, ROSC detection	Standard of care in most systems; qualitative + quantitative
Lactate	Occult hypoperfusion in trauma, sepsis screening	CLIA-waived (Lactate Pro devices); ~$1.80–$2.80/test; normal (<1.0 mmol/L) may help avoid over-triage
Troponin	Chest pain triage, PCI destination decision	CLIA-moderate; expensive (~$15/test); start test on scene, read during transport; high specificity (99.2%) for PCI destination
INR/PT	Stroke treatment decisions, anticoagulated trauma patients, TBI	CLIA-moderate; ~$9/test; useful in mobile stroke units (German data: ↓ time to needle)
CO Oximetry	Fireground carbon monoxide exposure	CLIA-waived; breath analysis or pulse co-oximeter; limitations: baseline CO in smokers, cumulative exposure
BNP	CHF vs. COPD differentiation	Studies too heterogeneous; theoretical benefit; limited prehospital data
POC Blood Gas	Stabilization prior to interfacility transfer	↓ Time, cost; affects clinical decisions
Hemoglobin/Hematocrit	Suspected GI bleed, trauma triage	Theoretical benefit; ↓ over-triage

Community Paramedicine POC

Rule-in: initiate treatment or activate emergency response
Rule-out: greater utility with longer contact times and old records
Unique applications: urinalysis, peak flow, electrolytes, BNP for ongoing chronic disease monitoring
Los Angeles APRU (paramedic + NP): 50.5% treat-and-release or alternate destination; low ED recontact

Key Considerations for Implementation

Factor	Description
Validity	How well POC compares to lab version
Test characteristics	Sensitivity/specificity, pretest probability
System responsiveness	Can protocols act on results?
Logistics	Refrigeration? Battery life? Weight? Shelf life?
Cost	Device (~$5,000–$7,000) + per-test cartridges + maintenance
Reimbursement	Often no billing code for prehospital POC
CQI	Mandatory; performance measures defined a priori
Scene time	Does it extend scene time → does the outcome benefit justify it?

PRIORITY PATCH

CLIA-Waived: blood glucose, urine pregnancy, CO oximetry, POC lactate (Lactate Pro); no accreditation required
CLIA-Moderate: ~70% of POC tests (troponin, INR, BMP); requires lab director, training docs, quality controls
Troponin: ~$15/test; specificity 99.2% for PCI destination decisions; start on scene, read during transport
INR: ~$9/test; used in mobile stroke units (Germany data: reduced time to needle)
Three questions before implementing any POC test: valid in field? changes clinical action? within EMS scope?

⚡PULSE CHECK

QUESTION 1

Fingerstick blood glucose falls under which CLIA regulatory category?

A. CLIA-Waived
B. CLIA-Moderate Complexity
C. CLIA-High Complexity
D. Exempt --- prehospital only

Answer: A

Fingerstick blood glucose is CLIA-Waived --- the simplest category, usable without laboratory accreditation. CLIA-Moderate Complexity (~70% of POC tests, including troponin and INR) requires lab director oversight, technical consultation, and quality controls.

QUESTION 2

Before implementing a POC test, EMS medical directors should ask which three core questions?

A. Cost, reimbursement, and state regulatory approval
B. Test validity/reliability prehospitally, whether it will change clinical action, and if it is within EMS scope/infrastructure
C. Whether FDA-approved, whether hospitals use it, and CLIA level
D. Sensitivity, specificity, and PPV in prehospital populations

Answer: B

Three core questions: (1) Is the test valid/reliable in prehospital conditions? (2) Will it change clinical action and does the system allow response to results? (3) Is it within EMS scope, education, and infrastructure? All POC use requires physician orders and CQI.

QUESTION 3

Prehospital POC lactate testing (CLIA-waived) is primarily used for:

A. Confirming STEMI
B. Occult hypoperfusion screening in trauma and sepsis
C. Measuring coagulation status
D. Determining etiology of AMS

Answer: B

Prehospital POC lactate screens for occult hypoperfusion in trauma and sepsis. EtCO2 inversely correlates with serum lactate and serves as a surrogate when POC lactate is unavailable. POC lactate is CLIA-waived on devices like the Lactate Pro.

69 Ultrasound Applications in the Prehospital Setting

Why Prehospital Ultrasound?

Only 4.1% of NAEMSP EMS directors use it currently (survey)
Potential benefits: improved triage, changed diagnosis, earlier therapy, informed destination, advanced hospital notification
Insufficient evidence to confirm effect on morbidity/mortality, but multiple reviews cite promising preliminary data
Rated as one of **top 5 research priorities** for EMS systems in Europe

Core Applications

Trauma; FAST & eFAST
Most extensively studied prehospital ultrasound application
Detects: cardiac tamponade, intraperitoneal hemorrhage, hemothorax, pneumothorax
Walcher (Germany): prehospital FAST changed management in **30% of patients** (reduced unnecessary interventions, changed destination in 22%, activated surgical teams)
Limitations: cannot distinguish blood from ascites, misses retroperitoneal fluid, hollow viscus, diaphragm rupture; serial exams recommended

Pulmonary
Pneumothorax: absence of lung sliding: prehospital eFAST; may facilitate field needle thoracostomy or chest tube
Pulmonary edema: B-lines → helps differentiate CHF vs. COPD vs. ACS
Pleural effusion: supports decompensated CHF vs. COPD
ETT placement: bilateral diaphragm excursion + bilateral pleural sliding → ↑ sensitivity/specificity vs. capnography alone

Cardiac
Pericardial effusion/tamponade: eFAST; has enabled field pericardiocentesis
Cardiac arrest: absence of cardiac activity predicts unsuccessful resuscitation: 3.1% survival to hospital admission with cardiac standstill on prehospital TTE
Do NOT base TOR on single initial scan: small subset of standstill patients do survive to hospital admission
PEA vs. "pseudo-PEA": differentiating fine VF vs. true standstill; guides defibrillation vs. stopping resuscitation
Caution: TTE during CPR may cause significant delays in pulse check pause

Abdominal
AAA: prehospital diagnosis → change management, direct to vascular surgery, reverse anticoagulation
Useful in remote/disaster settings where other imaging unavailable

Obstetric
Fetal cardiac activity and gestational age: during high-noise air medical transport; guides perimortem C-section decisions
Ruptured ectopic/uterine rupture: free fluid in RUQ → altered management
Prevents air transport in fetal distress (prolapsed cord case)

Musculoskeletal
EMT-detected simulated fractures; fracture evaluation in combat/remote environments
Ultrasound-guided nerve blocks: paramedic-performed fascia iliaca blocks for hip/femoral fractures → improved pain control vs. standard analgesics

Neurologic
Transcranial Doppler: feasible for MCA/ICA stroke screening by field neurologists (high specificity); not ready for paramedic-run systems
Optic nerve sheath diameter: surrogate for elevated ICP; useful in remote/austere environments

Procedural
IV access guidance: ↑ success rates in difficult access
Ultrasound-guided pericardiocentesis during transport (non-physician critical care transport case report)
Growing interest in prehospital REBOA and ECMO guidance

EMS Protocols

Protocol	Application
PAUSE	Prehospital Assessment with Ultrasound for Emergencies: heart + thorax; pericardial effusion, pneumothorax, cardiac motion
CAVEAT (military)	Chest (pneumo/hemothorax/tamponade), Abdomen (FAST), Vascular (IVC for volume), Extremity (fracture)

Training

Non-physicians can achieve proficiency with appropriate training
FAST training: 1-day courses with high accuracy reported
Optimal training time/method: no current consensus
Cardiac standstill training: many curricula too short; minimum competency standards not established
Methods: lectures, hands-on proctoring, OSCE, web-based modules, flashcards, tele-ultrasound guidance

Tele-Ultrasound

Centralized expert guides remote unskilled clinician
51 paramedics (no prior US experience): complete FAST exams in median **262 seconds** after 20-min didactic + tele-guidance
Improving cellular/satellite networks → increasing accessibility in remote areas
Tablet ultrasound machines with tele-guidance capabilities now commercially available

Technical Feasibility

Barriers: insufficient time, ambient light (screen visibility), spatial constraints, patient factors (obesity, subcutaneous emphysema, combativeness), battery/machine failure
Ground transport: measurably longer completion times but not statistically/clinically significant; no prolongation of transport time in multiple studies
Equipment trajectory: ↓ size, ↓ cost, ↓ weight; need robust rugged devices, good visibility in sunlight, wireless transmission capability

PRIORITY PATCH

Only **4.1%** of NAEMSP EMS directors use prehospital US currently (survey data)
FAST changed management in **30% of patients** in Walcher study (Germany); changed destination in 22%
Cardiac standstill: 3.1% survival to hospital admission; **do NOT base TOR on single scan alone**
TTE during CPR: may cause significant delays in pulse check pause; use with caution
Tele-ultrasound: 51 paramedics completed FAST in median 262 sec after 20-min training + remote guidance

⚡PULSE CHECK

QUESTION 1

Which prehospital ultrasound application has the most robust evidence base?

A. Peripheral IV guidance
B. Cardiac function during resuscitation
C. Trauma/FAST and eFAST
D. Pulmonary edema differentiation

Answer: C

FAST/eFAST is the most extensively studied prehospital US application. Walcher (Germany) found prehospital FAST changed management in 30% of patients. Currently only 4.1% of EMS directors use prehospital US.

QUESTION 2

Absence of cardiac activity on ultrasound during cardiac arrest resuscitation predicts:

A. Reversible cause requiring escalated therapy
B. Need for ECMO
C. Unsuccessful resuscitation (approximately 3.1% survival)
D. Pericardial tamponade requiring pericardiocentesis

Answer: C

Absence of cardiac activity in cardiac arrest predicts unsuccessful resuscitation with approximately 3.1% survival. This data supports its use in termination of resuscitation decisions. Cardiac tamponade (effusion + clinical shock) on FAST has enabled field pericardiocentesis.

QUESTION 3

Which ultrasound finding helps differentiate CHF from COPD exacerbation?

A. Absent lung sliding
B. B-lines (comet tail artifacts)
C. Lung point sign
D. Diaphragm flutter

Answer: B

B-lines (comet tail artifacts extending from the pleura) indicate interstitial fluid consistent with pulmonary edema/CHF. Absent lung sliding indicates pneumothorax. The lung point sign is pathognomonic for pneumothorax.

70 Medical Oversight of EMS Systems

The EMS Medical Director Role

EMS medical director = physician vested with that title and responsibility by an agency or system to provide *medical oversight*
EMS physician = a medical director who self-identifies EMS as his or her practice of medicine
EMS agency = a single EMS-providing entity (fire department, private ambulance service)
EMS system = all elements integrating to deliver care from one or more agencies as part of the larger system of care
ABEM recognized EMS medicine as a subspecialty in **September 2010** (IOM 2006 report was the catalyst)
As of 2020: **831** EMS subspecialty board-certified physicians; **68** ACGME-accredited fellowships in the U.S.

Qualifications

Level	Requirements
Preferred	Board certification in EMS medicine + all minimum criteria below
Minimum	State licensure; board certification/preparedness (EM desirable); familiarity with local EMS; training/experience in clinical EMS, EMS medical direction, research; knowledge of EMD, operations, education, QA/QI, MCI/disaster, labor relations, finance, public health

Indirect Medical Oversight

Encompasses the **majority** of a medical director's activities
Includes: protocol development, credentialing, QA/QI, education
The medical director gives written definitions to the practice of EMS medicine in their community

EMS Clinician Education

State sets minimum licensure requirements; medical director can add local requirements
Education agenda emphasizes: national EMS education standards + national certification as prerequisite for state licensure + accredited EMS education programs
One-size-fits-all mandates set a minimum but fail both at-risk and high-achieving clinicians: tailor education when possible

Credentialing

Credentialing = the process that grants an EMS clinician the *privilege* to perform a prescribed role and specific skills within a service based on competency
Not the same as licensure: local credentialing is analogous to hospital privileging
Re-verification should occur **no less frequently than every 2 years**
Medical director must have authority to **immediately suspend or limit privileges** of incompetent or impaired clinicians (with due process)
High-risk, low-frequency skills (e.g., intubation, cardiac pacing) require special attention

QA/QI

QI is fundamentally **non-punitive**: identifies out-of-tolerance products, then studies underlying process
A **"just culture"** environment: all members share equal, non-punitive responsibility for identifying substandard processes
ePCRs enable automated quality filters (e.g., aspirin use in ACS)
NEMSIS: national EMS data repository for benchmarking
CARES: Cardiac Arrest Registry to Enhance Survival
Get With the Guidelines: stroke and CAD registries
HIPAA is commonly (and incorrectly) cited as a barrier to hospital outcome data: this is a **myth**; HIEs should enable bidirectional data flow

Protocol Development

Protocols guide field care and reflect medical director's intentions
May be "home grown" or provided by state/regional authorities
Emergency medical dispatch protocols = first interaction between EMS system and citizens; also require medical director oversight
Drug shortage planning: consider writing protocols by **drug class** rather than specific drug, with multiple standing orders in the same class

Base Stations

A base station = hospital ED or facility designated to provide direct medical oversight
Standards for base stations vary widely: no universal requirements exist in many systems

Staff answering EMS calls should know local protocols, equipment, meds, and scope of practice

Direct Medical Oversight

Real-time physician direction, provided **physically** or **virtually** (phone, radio, video)
Most modern direct oversight is remote; most systems have evolved away from mandatory call-for-orders for every case
Standing order protocols have been shown to be safe and effective
The trend: away from "call for orders" → toward a **consultative, collaborative approach**
The on-scene EMS clinician has information advantages the remote physician lacks: a collaborative approach serves patients best

Field Clinical Supervision

Medical directors should spend time in the field regularly
Bedside/field teaching is superior to classroom-only methods
Medical director's primary role in the field: evaluate clinicians' clinical reasoning and treatment plans; step in only when patient safety warrants it

Direct Patient Care in the Field

Medical directors may need to provide hands-on care in certain scenarios
Interventions Outside Typical EMS Scope

Interventions typically outside EMS scope	Examples
Medications not in protocols	Procedural sedation agents, specific vasopressors
Surgical procedures	Thoracotomy, escharotomy, pericardiocentesis, perimortem C-section, amputation
Access procedures	Venous cutdown, ECMO cannulation, IABO catheter
Other	Tube thoracostomy, reduction of dislocations

Legal and Regulatory Issues

DEA registration required for EMS agencies to carry controlled substances (both state AND federal)
Protecting Patient Access to Emergency Medications Act (2017) names the *ambulance service* (not the medical director) as the DEA license holder
CMS/Medicare: ALS reimbursement requires either an ALS intervention OR assessment by ALS clinician was warranted; non-emergency transport rules are more restrictive
42 CFR 410.4 governs CMS coverage of ambulance services
Relevant federal laws: HIPAA, HITECH, FDA (drugs/devices), OSHA, Airline Deregulation Act (air medical), Civil Rights/EEOC

Contract and Longevity Tips

Medical director's authority must be in a **written contract** regardless of compensation
Contract should define: title, authority, compensation, resources, chain of command
Key political tip: praise in public, criticize in private; engage local leaders; pick battles wisely

PRIORITY PATCH

ABEM recognized EMS medicine as subspecialty: **September 2010** (IOM 2006 report was the catalyst)
Credentialing ≠ licensure; credentialing is the local privilege within a system, analogous to hospital privileging; re-verify at least every 2 years
DEA registration: **ambulance service** is the license holder (not the medical director) per 2017 PPAEMA
HIPAA as barrier to hospital outcome data = **myth**; HIEs should enable bidirectional data flow
Medical director contract must be **written** regardless of compensation; must include authority to suspend/limit privileges

⚡PULSE CHECK

QUESTION 1

ABEM recognized EMS medicine as a subspecialty in which year?

A. 2006
B. 2010
C. 2013
D. 2019

Answer: B

ABEM recognized EMS as a subspecialty in September 2010 (the 2006 IOM report was the catalyst). The first EMS subspecialty exam was offered in 2013. As of 2020: 831 board-certified EMS physicians and 68 ACGME-accredited fellowships.

QUESTION 2

What distinguishes an 'EMS medical director' from an 'EMS physician'?

A. Medical director is board-certified; EMS physician is not
B. Medical director is vested with the title by an agency; EMS physician self-identifies EMS as their practice of medicine
C. Medical directors do system design only; EMS physicians provide direct care
D. EMS physicians must be emergency medicine specialists

Answer: B

EMS medical director = physician vested with the title and responsibility by an agency. EMS physician = a medical director who self-identifies EMS as their practice of medicine. Preferred qualification: board certification in EMS medicine.

QUESTION 3

Which of the following is an example of indirect (offline) medical oversight?

A. Riding along on ambulance calls to observe paramedic performance
B. Providing online medical direction during a complex resuscitation
C. Protocol development, credentialing, and QA/QI
D. Responding to a multi-vehicle crash scene

Answer: C

Indirect (offline) oversight encompasses the majority of a medical director's activities: protocol development, credentialing, QA/QI, education, and system design. Direct (online) oversight includes real-time consultation, radio/phone direction, and scene response.

71 Principles of EMS System Design

Goals of EMS System Design

Clinical quality, service quality, economic efficiency, accountability, improvement, resilience
Value = combined effect of quality and cost (communities want both)
Talented people produce good results even in bad systems: but not for long; bad design makes consistent life-saving performance nearly impossible

Services in a Comprehensive EMS System

Prevention and public education
Triage
Medical first response
Ambulance response and transport
Mobile integrated health care / community paramedicine (MIH/CP)
Pre-arrival instructions
Assessment and treatment
Medical transportation
Mass gatherings
Disaster preparedness and management
Interfacility / critical care transport
Air medical transport
Hazardous materials response medical support
Tactical response medical support

Ground Ambulance Types

Type	Chassis	Pros	Cons
Type I	Light-medium truck; box patient compartment	Long service life; remountable module	Harder to navigate congested areas; less fuel efficient
Type II	Van (no box)	Agile; fuel efficient	Shorter service life; no remounting option
Type III	Van with separate box	More agile than Type I; long service life	Less fuel efficient

Standards: **KKK-A-1822** (Star-of-Life federal spec) and **NFPA 1917** (automotive ambulances)

Delivery Settings

Urban/Suburban
Multiple EMS providers possible in same metro area: coordination critical
System-level medical oversight often at county/regional level to ensure interoperability
All-ALS vs. mixed BLS/ALS debate:
All-ALS: never under-triage; each unit qualified to "stop the clock"
Counter-argument: diluted opportunities for high-risk procedures (e.g., intubation)
AEMT expanded scope now questions whether paramedic level is always necessary

Rural
Low tax base; difficulty funding expensive technology
Creative staffing: respond from home/work to the ambulance or directly to scene
Tiered response: BLS first, ALS intercept (non-transport vehicle) common
Rural paramedic paradox: highest need for ALS (long distances, longer patient contact) in the places least resourced to provide it
Same paradox applies to mobile integrated health care

Industrial
Site-specific EMS; must coordinate with local medical director and jurisdiction
Requires special protocols for unique hazards (chemical, etc.)

International Models

Model	Staffing	Philosophy
Anglo-American	Non-physicians; EMT/paramedic	"Scoop and run": defer to hospital
Franco-Germanic	Physician-staffed	"Stay and play": on-scene stabilization
Netherlands (hybrid)	Critical care nurses with paramedic training	Autonomous treat-and-release; no physicians in field routinely

Provider Organization Types

Type	Key Advantages	Key Disadvantages
Fire-based	Infrastructure already in place; dual-function; rescue integration	Higher personnel costs; 24-hr shifts limit SSM; EMS may be "step child" to fire
Law enforcement	Infrastructure for rapid response; excess capacity in some agencies	Less common; culture/priority conflicts; rare as ambulance provider
Municipal (third service)	EMS-focused; specialized management; clinicians' sole duty is EMS	Perceived higher cost; dependent on fire for first response; identity issues
Private	Focus on EMS; efficiency incentives; may not need subsidy if volume is sufficient	Profit vs. patient care tension; requires active regulatory oversight
Hospital-based	Clinical/educational assets of hospital; career ladder options	Hospital may not have EMS operational expertise; billing complications
Volunteer	Community-based; low cost	Reliability issues as call volume grows; may shift to hybrid paid/volunteer model

Allocation of ambulance service market rights = designating a single or limited ambulance provider; allows competition *for* the market rather than *within* the market; most powerful tool in EMS system design

Deployment Planning

Type	Description	Best For
Static	Units stationed 24/7 at fixed locations	Fire, municipal EMS; predictable coverage
Dynamic	Geotemporal analysis; deploys based on demand patterns; SSM	Cost efficiency; high-volume urban systems
Real-time	GPS + traffic data updates deployment live	Refinement of dynamic deployment
Hybrid	Mix of fixed stations + dynamic posts	Systems with urban + rural zones

Performance Standards

Historically: response time targets (% of calls meeting X-minute response)
Evidence now shows response time has limited impact on outcomes **except for cardiac arrest** (survival drops ~10%/minute without CPR)
Shifting toward **process-based metrics**: CPR quality (chest compression fraction), STEMI alert accuracy, stroke scale documentation, pre-/post-defibrillation pauses

PRIORITY PATCH

Anglo-American model = scoop & run (non-physician); Franco-Germanic = stay & play (physician-staffed): know the contrast for the exam — **neither model has demonstrated universal outcome superiority**
Type I = truck chassis + remountable box; Type II = van (shortest service life, no remount); Type III = van + box; standards: KKK-A-1822 being **superseded by NFPA 1917** as primary standard
Dynamic deployment (SSM) reduces unit hours but risks crew burnout; Northridge earthquake (4:30 AM) = canonical SSM failure example — *unpredictable surge demand* overwhelmed the geotemporal optimization, not merely crew fatigue
All-ALS: never under-triage but dilutes intubation volume; **rural paramedic paradox**: highest ALS need, least resource to provide it
Performance metrics shifting from response time to **process-based** (CPR fraction, STEMI alert accuracy); cardiac arrest is the one exception where response time still matters — specifically **shockable rhythms (VF/VT)**: survival drops ~10%/min without CPR

⚡PULSE CHECK

QUESTION 1

Which ambulance type uses a van chassis without a box body, offering agility and fuel efficiency but a shorter service life?

A. Type I
B. Type II
C. Type III
D. Type IV

Answer: B

Type II: van chassis, no box body. Pros: agile, fuel efficient. Cons: shorter service life, cannot remount module. Type I: light-medium truck with remountable box. Type III: van with separate box --- more agile than Type I, longer service life.

QUESTION 2

EMS system value is defined as:

A. Value = Quality + Safety
B. Value = Combined effect of quality and cost
C. Value = Response time × Clinical outcome
D. Value = Unit hour utilization × cost per call

Answer: B

Value = the combined effect of quality and cost. Communities want both clinical quality and economic efficiency. Bad system design makes consistent life-saving performance nearly impossible, even for talented people.

QUESTION 3

Mobile Integrated Health Care/Community Paramedicine (MIH/CP) is explicitly listed among which group of services?

A. Optional quality improvement programs
B. Components of a comprehensive EMS system
C. Federally mandated EMS services
D. Services excluded from traditional EMS scope

Answer: B

MIH/CP is one of the explicitly listed components of a comprehensive EMS system, alongside prevention/education, triage, ambulance response, mass gatherings, disaster preparedness, interfacility transport, air medical transport, hazmat, and tactical support.

72 Emergency Care Regionalization

Key Definitions

Term	Definition
Regionalization	Coordinated system of care across a geographic area combining all necessary components to optimize patient outcomes
Categorization	Classification of facility capabilities against accepted standards
Designation	Formal selection of a facility for specialty patient referral by a legally authorized organization
Time-Critical Diagnosis (TCD)	Concept that a coordinated system should manage all time-critical conditions (trauma, STEMI, stroke) under one framework: avoids creating separate parallel systems
Simultaneous processing	Concurrent activation of multiple resources rather than sequential A→B→C; e.g., field-activated cath lab team arrival at same time as patient
"Moving care forward"	Earlier performance (by lower-acuity clinicians/EMS) of tasks traditionally reserved for higher-level clinicians later in sequence
Bypass	EMS protocol allowing transport past a closer hospital to an appropriate specialty center
Diversion	Hospital declines inbound EMS traffic due to internal capacity issues

Historical Background

1966 "Accidental Death and Disability" report (NAS): seminal document inspiring regionalization
1971: Illinois founded first regionalized system
1973: EMS Systems Act: federal grants for nationwide EMS shift from funeral-home ambulances to professional systems
1990: PL 101-590 Trauma Care Systems Planning and Development Act
Authorized but initially underfunded ($5M vs. projected $75M)
Goals: (1) remove barriers; (2) grants for coordinated systems; (3) required 24-hour specialist availability
Addressed antitrust authority issues
2001 & 2007: HR 727 amendments gave additional funding
1981 Omnibus Budget Reconciliation Act (OBRA): ended direct federal EMS funding → shifted burden to state/local; explains the intermittent nature of federal support thereafter
Federal support has been intermittent; **most regionalization funding now at state/local level**

Legal/Antitrust Considerations

Designation creates de facto monopolies → potential **Sherman Antitrust Act** exposure
Protection: **explicit statutory authority** at the state level
Key case: **Huron Valley Hospital Inc. v. City of Pontiac**: state regulatory actions within valid legislation are exempt from antitrust under "state action" defense
Colorado and Pennsylvania use independent foundations (not government) for trauma designation — this sidesteps government antitrust exposure; note: the "state action" defense requires **active state supervision**, not merely an enabling statute
Example: Texas Administrative Code §157.133 mandates transport to stroke center if within 10 minutes of a non-designated facility

Outcomes Evidence

Condition	Evidence for Regionalization
Trauma	~50% average reduction in preventable mortality in formal systems vs. no system or self-designation; San Francisco (formal) vs. Orange County (none): 1/92 vs. 22/30 potentially preventable deaths
Stroke	Decreased mortality and improved functional outcomes; every 15-min reduction in door-to-needle time = 5% lower in-hospital mortality; treatment window extended to 4.5 hours for tPA; thrombectomy up to 24 hours in selected patients
STEMI	AHA Accelerator-2 (2015-2017): mortality 4.4% → 2.3% with regional coordination; up to 50% of STEMI patients still self-transport

Stopping at a non-specialty facility for "stabilization" adds average **79 minutes** to definitive care
Stopping at outside facility vs. direct: 4.3% vs. 0% mortality in one STEMI study

Stroke Center Levels

Acute Stroke Ready Hospital
Primary Stroke Center
Thrombectomy-Capable Stroke Center (intermediate tier, emerging)
Comprehensive Stroke Center
Prehospital LVO screening tools: under development; some systems incorporating into protocols

Diversion and Bypass

Diversion = symptom of ED overcrowding, not a treatment for it
Must be governed by **prospectively established criteria**, not ad hoc decisions
Massachusetts moratorium on diversion (2009): no significant negative impact on ED throughput
Medical director should treat diversion as a **courtesy** extended to the receiving hospital, not an automatic right
EMS medical directors should advocate for systems that **minimize or eliminate routine diversion**

Future Directions

Telemedicine and telestroke already expanding (see Ch. 73)
Wearable devices detecting arrhythmias → automated dispatch
AI for dispatch optimization, triage assistance, LVO detection
EHR/ePCR data linkage for complete care continuity
"GIGO principle": all data technology depends on quality input data

PRIORITY PATCH

1966 "Accidental Death and Disability" (NAS) = seminal regionalization document; **1973** EMS Systems Act = first federal funding; **1990** PL 101-590 = Trauma Care Systems Act
Trauma: ~**50% reduction in preventable mortality** in formal systems; stopping at non-specialty facility adds avg **79 min** to definitive care
Stroke: every **15-min** reduction in door-to-needle = **5% lower in-hospital mortality**; tPA window 4.5 hr; thrombectomy up to **24 hr in selected patients** (DAWN/DEFUSE-3 criteria: large penumbra on imaging, small infarct core)
STEMI regionalization (AHA Accelerator-2): mortality 4.4% → 2.3%; direct vs. outside facility first: 0% vs. 4.3% mortality in one study
Diversion = symptom of ED overcrowding, not a treatment for it; medical director should treat it as a **courtesy**; Massachusetts moratorium (2009) had no negative throughput impact

⚡PULSE CHECK

QUESTION 1

'Simultaneous processing' in regionalized care refers to:

A. Multiple EMS units responding to the same call simultaneously
B. Concurrent activation of multiple resources so they arrive at the same time as the patient
C. Running multiple QI reviews simultaneously
D. Parallel communication between hospital and EMS during transport

Answer: B

Simultaneous processing: concurrent activation of multiple resources rather than sequential A→B→C. Example: field-activated cath lab team arriving simultaneously with the STEMI patient. Opposed to sequential activation which adds time at each step.

QUESTION 2

The first regionalized emergency care system in the U.S. was founded in:

A. California (1968)
B. New York (1969)
C. Illinois (1971)
D. Maryland (1970)

Answer: C

Illinois founded the first regionalized emergency care system in 1971, following the 1966 'Accidental Death and Disability' NAS report. The 1973 EMS Systems Act then provided federal grants to nationalize the shift from funeral-home ambulances to professional systems.

QUESTION 3

The Time-Critical Diagnosis (TCD) framework was developed to:

A. Standardize prehospital ECG interpretation times
B. Manage all time-critical conditions (trauma, STEMI, stroke) under one framework --- avoiding parallel specialty systems
C. Define door-to-needle time for fibrinolytics
D. Establish triage protocols for mass casualty events

Answer: B

TCD framework: a coordinated system should manage all time-critical conditions under one framework --- avoiding creating separate, parallel specialty systems that duplicate infrastructure and complicate coordination.

73 Telemedicine and Emerging Telecommunications

Definitions

Telemedicine/Telehealth = medical information exchanged from one site to another via electronic communications to improve a patient's clinical health status
Synchronous: real-time exchange
Asynchronous (store-and-forward): recorded data reviewed at a later time

Four Categories of EMS Telemedicine (Norris)

Category	Description	EMS Examples
Teleconsultation	Voice, video, data exchange for consultation	Base station radio/phone calls; video DMO; refusal consultations
Telementoring/Telesurgery	Expert guides less-experienced clinician performing a procedure	"Telebation" (video laryngoscope-guided intubation); tele-ultrasound
Telemonitoring	Remote real-time tracking of patient data	ECG transmission; vital signs monitoring
Tele-education	Remote training and education	Simulation; online learning

Telecardiology

STEMI goal shifted from "door-to-balloon ≤90 min" to **"first medical contact to device ≤90 min"** (2013 ACCF/AHA)
ECG transmission (12-lead via cellular to fax or digital) enables **early cath lab activation**
Prehospital fibrinolytics guided by ECG transmission more common in Europe; rare in U.S.
Key studies: Björklund (Sweden): remote ECG transmission + phone consult → 1-hour reduction in time to treatment + **30% reduction in 1-year mortality**

Telestroke

TeleBAT (University of Maryland, 2000): demonstrated feasibility of remote neurologist stroke evaluation in ambulance via cellular videoconferencing
Cleveland Clinic mobile CT + teleneurology: reduced time to treatment but **no demonstrated morbidity/mortality benefit**; high cost limits feasibility
Video evaluation by remote neurologist: reduced door-to-needle time by ~13 minutes
Prearrival stroke notification → increases thrombolytic use and stroke unit placement

Refusal of Medical Care

Patients speaking directly with physician (by phone) agree to transport at 35% vs. 3% when speaking only to EMS clinicians
More assertive physician communication → higher transport rates in concerning cases
Video adds "social presence" and may further improve patient compliance

Mobile Integrated Health Care / Community Paramedicine

Houston ETHAN (Emergency Telehealth and Navigation): reduced hospital transports by **56%**; saved ~$100/visit vs. ED visit cost
ET3 (Emergency Triage, Treat, and Transport) model: CMS pilot program paying select agencies for:
On-scene treatment without transport
Transport to non-ED destinations
Requires on-site evaluation by CMS practitioner **or** telemedicine

Telemonitoring

Einthoven transmitted the first ECG in 1905; first remote monitoring for space medicine 1961 (Yuri Gagarin)
Current prehospital monitoring: HR, BP, SpO2, EtCO2, ECG, glucose
Evidence: improved preparation at receiving facility; limited direct evidence for improved outcomes except in stroke, MI, and brain injury

Telementoring

Airway Management

Korea TAMS (2007): remote physician guidance → intubation success within 2 min: **94% (TAMS) vs. 63% (video alone)**
"Telebation" (Mosier, University of Arizona): 4G cellular VoIP allows real-time video with adequate quality for airway guidance
Pediatric pDART (Johns Hopkins): smart glasses + video laryngoscope + 24/7 pediatric airway expert

Tele-Ultrasound

Remote physician can guide FAST exam image acquisition in under 5 minutes
Feasibility demonstrated; further evidence needed for outcomes improvement

Tactical and Military Applications

Tac-Tel (Palm Bay, FL): tactical medic → direct audio/video to trauma surgeon
Military origin of telementoring: field medics in combat linked to surgeons remotely
Key challenge: devices must be discreet, lightweight, rugged, and maintain secure connectivity

Disaster Medicine Applications

WIISARD: wireless real-time patient tracking and condition monitoring for MCIs
miTag: electronic RFID triage tag with real-time vital transmission to incident command
Smart Glasses + mobile app: augmented reality for remote physician scene awareness; better quality information despite longer triage time
Post-event: photos/video used for scene reconstruction, investigation, and training (e.g., ADMR course via telemedicine for 2014 FIFA World Cup)

PRIORITY PATCH

STEMI telecardiology: **first medical contact to device ≤90 min** applies when EMS = first contact (2013 ACCF/AHA); door-to-balloon ≤90 min still applies for walk-in patients; field ECG transmission enables early cath lab activation
Telestroke: remote neurologist video → door-to-needle reduced ~13 min; prehospital mobile CT (Cleveland Clinic) reduced time but **no mortality benefit** and high cost
Refusal calls: physician phone contact → patient agrees to transport **35% vs. 3%** with EMS-only communication
Houston ETHAN: reduced hospital transports by **56%**; CMS ET3 pilot pays for on-scene treatment without transport or transport to non-ED destination
Korea TAMS telementoring: intubation success ≤2 min = **94% (TAMS) vs. 63% (video alone)**
Norris 4-category EMS telemedicine framework: Teleconsultation · Telementoring/Telesurgery · Telemonitoring · Tele-education — used to classify clinical scenarios on exam

⚡PULSE CHECK

QUESTION 1

The 2013 ACCF/AHA STEMI benchmark shifted from 'door-to-balloon ≤90 min' to which new standard?

A. Scene-to-balloon ≤60 minutes
B. First medical contact to device ≤90 minutes
C. First medical contact to balloon ≤120 minutes
D. Symptom onset to device ≤180 minutes

Answer: B

The 2013 ACCF/AHA guideline shifted to 'first medical contact (FMC) to device ≤90 min,' emphasizing prehospital ECG transmission and early cath lab activation --- not just the hospital door.

QUESTION 2

The Björklund Swedish study on remote ECG transmission showed:

A. 30% reduction in 30-day mortality
B. 1-hour reduction in time to treatment and 30% reduction in 1-year mortality
C. Elimination of STEMI misidentification
D. 50% reduction in unnecessary cath lab activations

Answer: B

Björklund: remote ECG transmission + phone consultation → 1-hour reduction in time to treatment AND 30% reduction in 1-year mortality. Prehospital fibrinolytics guided by ECG transmission are more common in Europe than in the U.S.

QUESTION 3

'Telebation' (video laryngoscope-guided intubation by a remote expert) is classified as which telemedicine category?

A. Teleconsultation
B. Telemonitoring
C. Telementoring/Telesurgery
D. Tele-education

Answer: C

Telementoring/Telesurgery (Norris category): expert guides a less experienced clinician performing a procedure. Teleconsultation: voice/video/data exchange for consultation. Telemonitoring: remote real-time data tracking (ECG, vitals). Tele-education: remote training.

74 Interfacility Transportation

Overview

Interfacility transport = transportation of a patient from one acute care setting to another
Sending physician is responsible for: choosing the receiving facility, mode of transport, level of care, required equipment
As regionalization grows, interfacility transport becomes more integral to specialty care

Level of Care Decision

Level	Description	Typical Use
Nonmedical	POV, taxi, ride-share, accessible vehicle	Stable patient, no anticipated medical need
BLS	EMTs	Low-acuity, stable, basic monitoring only
ALS	Paramedics	Majority of interfacility transports; medications, advanced monitoring
Critical Care	Specially trained paramedics + nurses	Invasive monitoring, expanded drug formulary, advanced critical thinking
Specialized	Critical care team + perfusionist, RT, MD, etc.	Neonatal, ECMO, IABP, obstetric, burn

Consider both **total transport time** AND **out-of-hospital time**
Example: BLS available immediately, 1-hour transport = 60 min OOH
Critical care air team: 45-min delay + 20-min flight = 65 min total BUT only 20 min OOH
OOH time may matter more than total time for some conditions

Modes of Transportation

Mode	Advantages	Disadvantages	Best For
Ground ambulance	Space, availability, lower cost	Slower than air	Most interfacility transports
Rotor-wing (helicopter)	Speed, advanced team, no road dependency	Cost, weather dependent, space limited	Time-critical (STEMI, stroke, trauma) ≤~150 miles
Fixed-wing (airplane)	Speed, long distances, IFR capable, more space	Airport required at both ends, cost	>150-175 miles; repatriation; better weather capability
Private vehicle/taxi	Inexpensive, immediate	No trained personnel	Very stable, no anticipated interventions needed

Clinical Indications for Interfacility Transport

Condition	Key Points
Trauma	Goal: definitive intervention before hemorrhagic shock or TBI becomes irreversible; minimize scene time at sending facility
STEMI	Minimize D2B; be prepared for LVAD, ECMO, IABP, temp pacemaker management
Stroke	tPA window: **4.5 hours**; LVO: thrombectomy up to **24 hours**; transfers outside window may still be beneficial but less urgent
Burns	Immediate threats: volume loss, airway, CO/CN; intubate **before** transport if ANY concern for airway compromise; CO + altitude = compounding toxicity even after O_2 therapy; prefer ground transport for significant CO exposure when feasible; CN resolves quickly (arrest or seize = pre-transport, not en route)
Obstetrics	Almost always for the fetus; cervical dilation **>4 cm** = most reliable sign of imminent delivery; fetal distress → C-section before transport; EMTALA = woman in active labor is "unstable"
Neonatal/Pediatric	Specialized equipment and caregivers essential; AAP has published transport guidelines
Spinal cord injury	Transfer for cord compression or deficits; BLS acceptable for low-risk spine patients

Hazards of Interfacility Transport

Lights and siren: routine use is **not appropriate** for most interfacility transports; risks to crew and public exceed benefit; if truly time-critical, consider air instead
Unstable patients: EMTALA requires stabilization to extent possible before transfer; manage anticipated airway issues at the sending facility (better equipment, space, staff)
Volatile gatherings: potential for crowd obstruction, projectiles, drone interference with air transport; plan alternate routes
Disasters: coordinate with local/regional experts; unique hazards of each disaster type

Medical Oversight of Interfacility Transport

More complex than scene-response oversight
Multiple physicians often involved as medical directors
Whoever provides direct oversight **must** know: protocols, transport equipment, medication formulary, all team members' competencies, and capabilities of both referring and receiving facilities
Most transports need limited direct oversight; chart audit and review is the primary QI mechanism
Multidisciplinary review (EMS, nursing, referring and accepting physicians) is ideal for QI
Interstate transports: verify **licensing requirements** in all states crossed

EMTALA Summary

Medical screening exam required before transfer
If unstable or in active labor: must provide care until stable (regardless of ability to pay)
Legal transfer of unstable patient is allowed when:
Patient requests transfer after informed consent
Sending hospital cannot provide needed service
Receiving hospital can provide and explicitly agrees to accept
Patient consents after informed consent
Transfer paperwork must travel with patient: transfer form, medical record, imaging (actual images preferred), lab results
Accepting "representative" does not have to be a physician (e.g., charge nurse for ICU)

Videoconferencing in Interfacility Transport

Increasingly used: video consults with specialists before transport; notifications with data sharing en route
Can share video, photos, ECGs, labs, imaging results
Ideal for STEMI and trauma (early specialist team activation concurrent with transport)

PRIORITY PATCH

Sending physician is responsible for: receiving facility choice, transport mode, level of care, required equipment
Out-of-hospital time vs. total transport time: critical care air (45-min delay + 20-min flight) beats BLS ground (60-min transport) by 40 min of OOH time
Obstetrics: cervical dilation **>4 cm** = likely delivery en route; fetal distress = C-section first, THEN transfer; EMTALA active labor = **contractions with insufficient time to safely transfer OR patient request** — always "unstable" regardless of clinical appearance
Burns: intubate **before** transport if ANY airway concern; CN toxicity resolves quickly (if arresting or seizing, treat pre-transport, not en route)
EMTALA unstable transfer: legal only if (1) patient requests after informed consent, (2) sending facility cannot provide needed service, (3) receiving facility can and explicitly agrees

⚡PULSE CHECK

QUESTION 1

Which level of interfacility transport requires specialized personnel including perfusionists, respiratory therapists, or physicians?

A. BLS transport
B. ALS transport
C. Critical care transport
D. Specialized transport

Answer: D

Specialized transport includes critical care team + perfusionist, RT, MD, etc. --- used for neonatal, ECMO, IABP, obstetric, and burn patients. Critical care (Level 4) uses specially trained paramedics + nurses with invasive monitoring and expanded formulary.

QUESTION 2

When comparing total transport time vs. out-of-hospital (OOH) time for interfacility decisions:

A. Total transport time always dictates mode selection
B. OOH time may matter more than total transport time for some conditions
C. Patient acuity overrides both time metrics
D. Weather is the primary determinant

Answer: B

OOH time (time outside a medical facility) may matter more than total transport time for some conditions. Example: BLS immediately available, 1-hr transport = 60 min OOH. Critical care air: 45-min delay + 20-min flight = 65 min total BUT only 20 min OOH --- which may be preferable for unstable patients.

QUESTION 3

The sending physician is responsible for which components of interfacility transport?

A. Only the patient's care until EMS arrival
B. Choosing the receiving facility, mode of transport, level of care, and required equipment
C. Only ensuring stability before EMS departure
D. Coordinating insurance authorization

Answer: B

The sending physician is responsible for: choosing the receiving facility, mode of transport, required level of care, and required equipment. This is a direct physician responsibility.

75 Air Medical Services

Global Models

Model	Staffing	Primary Objective
European/Japanese	Specialist physician-led	Deliver immediate specialist care on scene; often followed by ground transport
United States	Nurse/paramedic team; advanced scope	Scene response + interhospital transport; reimbursement tied to transport
Developing nations	Paramedic or mixed paramedicine/physician	Essential medevac; cost-effective given poor road networks

Historical Milestones

Year	Event
1915	First military fixed-wing air evacuation
1926	U.S. Army Air Corps regular medical aviation use
WWII	First routine hospital-to-hospital air transport; first scene evacuation (Burma)
Korean War	Helicopter routinely used for patient transport (road conditions forced it)
Vietnam War	>800,000 injured soldiers; "dust-off" helicopter evacuation; lowest war fatality rate to date
1970	Dr. R. Adams Cowley + Maryland State Police: first civilian helicopter trauma program
1972	**First hospital-based helicopter program: St. Anthony's, Denver, CO**
1997	CMS Balanced Budget Act → significantly increased helicopter reimbursement
2019	1,115 dedicated rotorcraft from 959 bases; 359 fixed-wing from 212 bases (U.S.)

System Facts and Figures

Air medical transport = **~2%** of all U.S. ambulance transports
Average patients per helicopter/year: **298** (down from 882 in 2003 as fleet grew faster than volume)
Mission mix: **54% interhospital, 33% scene runs, 13% other** (neonatal, transplant, etc.)
Average flight distance with patient: **50–55 miles**
Cost: **4–10× more expensive** than ground transport
Fixed costs = **~84%** of total air medical provider costs

Growth Drivers

19% of U.S. population lives in rural areas; 30% of miles traveled; ~50% of fatal MVCs
27% of U.S. residents near Level I/II centers require HEMS to achieve timely access
42.8 million Americans in rural areas without timely specialist access
Rural hospital closures (179 between 2005–2020); 21% of remaining rural hospitals at risk of closure
Reduction in rural specialist availability (especially neurosurgery)
ED closures; Level I/II trauma center reduction; hub-and-spoke concentration of specialty care
ED overcrowding and diversion

Clinical Efficacy

Trauma: mean **3.8 lives saved per 100** patients with HEMS (range 1.1–12.1)
HEMS mortality benefit compared to ground: clear minimum **2.7 per 100 flight transports**
Over-triage (discharged from ED post-HEMS transport, no admission) = **10× increase in EMS interval cost**
Loss of HEMS availability → increased trauma mortality at non-Level I centers
Time elements:
Time to *team* (specialized care reaches patient) may be more important than time to *tertiary*

Time to tertiary (resuscitation, stabilization, transport interval)
Total time (cycle time)

System Benefits of HEMS

Extension of advanced care throughout a region (geography : time coverage ratio 1:6 vs. ground in urban U.S.; up to 1:50 in rural settings)
ALS "backup" for rural areas that would otherwise lose ground ALS coverage during long transports
Minimizing out-of-hospital time; direct transport to specialized centers (overflying less capable facilities)
Transport flexibility when hospitals are overloaded or on diversion
Disaster response: patient distribution, capacity smoothing, evacuation
"Go teams": transporting specialized clinicians or supplies to patients

Safety

HEMS = **one of the highest helicopter sectors for fatal crashes**
Most crashes: low-visibility conditions (VFR pilots, not IFR)
Only **<10%** of U.S. helicopter fleet operates IFR
NTSB major studies: 1988, 2006; NTSB "most wanted" list: 2008; major hearings 2009 (9 crashes, 35 fatalities)
FAA 2015 requirements: improved but do not fully address all NTSB recommendations
Post-impact fires remain a persistent, unmitigated crash fatality driver

Quality Metrics: GAMUT

GAMUT = Ground and Air Medical Quality Transport Quality Improvement Collaborative: voluntary QI benchmarking for air and critical care ground transport
27 consensus measures; >205 systems worldwide submitted data in 2019 (>350,000 transports annually)
Most testable metrics: ventilator use in advanced airways, first-attempt intubation success, **DASH-1A** (definitive airway without hypoxia/hypotension on first attempt), over-triage rate (HEMS patients discharged without admission), STEMI ECG interpretation accuracy, serious reportable event rate

Standards and Accreditation

ACCT (Association of Critical Care Transport): comprehensive consensus standards for critical care transport (medical oversight, scope of practice, equipment, quality)
CAMTS (Commission on Accreditation of Medical Transport Systems): voluntary; gold standard; 21 participating professional organizations; 161 accredited services (2021); recurrent accreditation required
European equivalent: European Aero-Medical Institute

Regulatory Framework

Authority	Scope
FAA (Federal)	All aviation: pilot rest/training, airspace, VFR/IFR, aircraft maintenance; **operational control**
State EMS agencies	Medical aspects: clinical protocols, personnel licensure, communications
CMS	Reimbursement (tied to transport)

Airline Deregulation Act: federal preemption → states CANNOT regulate rates, routes, or services of air medical services
FAA Part 91: general operating rules (applies to all aircraft including public providers like law enforcement)
FAA Part 135: air carrier/commuter/on-demand operations; **required for all HEMS with medical crew on board** (post-FAA Reauthorization 2011)
Operational control **always defers to the Part 135 certificate holder**: not the medical mission

Aircraft Operational Considerations

Factor	Helicopter	Fixed-Wing
Speed	100–155 kph	200–550 kph
Range	50–175 miles typical	500+ miles; transoceanic possible
Launch time	5–10 min	Longer (airport operations)
Ground transport required	Landing zone to/from scene	Both ends of flight require ground EMS
Weather	VFR limited; IFR only ~10% of fleet	More weather-capable; IFR standard
Break-even distance	—	>150–175 miles — dual ground-transport legs at both ends eliminate the speed advantage over shorter distances; beyond this threshold, speed overcomes the added legs
Space/weight	Very limited	More space; weight still a consideration

Special Considerations
Noise: history and auscultation must occur before loading; amplified/electronic stethoscope needed in flight
Lighting: red/blue lights at night to protect pilot night vision; NVG certification of aircraft lighting now widespread; sunlight can cause "flicker seizures" through rotor blades
Weight: pilot calculates max weight each shift based on temperature and altitude (high heat = less dense air = less lift)
EMI: all electronic equipment must be certified for aviation use; test before flight
Hazmat/infectious disease: contaminated patients should NOT be transported by air; each service needs a pre-established plan for highly infectious patients

Crew Configuration (USA)

93% of HEMS programs fly with **2 clinicians**
Most common combination: **flight nurse + flight paramedic (67%)**
Others: nurse/nurse (8%), nurse/physician (5%), paramedic/paramedic (5%)
Supplemental staff for specialized transports: perfusionist, RT, neonatal transport nurse, intensivist

Integration Challenges

HEMS growth has been driven by **market forces** more than health care planning
2019: >50% of HEMS base growth since 2012 was in areas already served by another aircraft
No standard formula for "right" number of helicopters per population/geography
CMS 2002 fee schedule: significantly increased helicopter reimbursement while ground specialty transport reimbursement was relatively decreased → loss of ground critical care capacity, increase in helicopter capacity
IOM 2006 recommendation: **states should assume regulatory oversight of medical aspects** of air medical services (communications, dispatch, transport protocols)

PRIORITY PATCH

First hospital-based helicopter program: **1972, St. Anthony's Hospital, Denver, CO**; **1997 CMS Balanced Budget Act** drove rapid growth via reimbursement increase
Air medical = ~**2%** of all U.S. ambulance transports; mission mix: **54% interhospital, 33% scene, 13% other**; avg flight distance 50-55 miles; 4-10× more expensive than ground
Airline Deregulation Act: federal preemption — states cannot regulate rates, routes, or services of air medical; **FAA Part 135** required for all HEMS with medical crew on board
Operational control **always defers to the Part 135 certificate holder**: if medical director and certificate holder disagree about flying, safety wins
HEMS = one of highest fatal crash sectors for helicopters; most crashes in low-visibility (VFR) conditions; only <10% of U.S. fleet is IFR-capable; post-impact fires remain unmitigated
HEMS growth is reimbursement-driven (1997 BBA), not need-driven; IOM 2006 recommended state medical oversight of air medical; this is **blocked by Airline Deregulation Act preemption** — a tested policy paradox

⚡PULSE CHECK

QUESTION 1

The first hospital-based helicopter program in the U.S. was established at which institution in 1972?

A. R Adams Cowley Shock Trauma, Baltimore
B. Denver Health Medical Center
C. St. Anthony's Hospital, Denver, CO
D. Hermann Hospital, Houston

Answer: C

St. Anthony's Hospital, Denver, CO established the first hospital-based helicopter program in 1972. Dr. R. Adams Cowley and Maryland State Police established the first civilian helicopter trauma program in 1970. The 1997 CMS Balanced Budget Act drove rapid fleet expansion.

QUESTION 2

What percentage of U.S. air medical missions are scene runs vs. interhospital?

A. 10% scene, 90% interhospital
B. 33% scene, 54% interhospital, 13% other
C. 50% scene, 50% interhospital
D. 67% scene, 33% interhospital

Answer: B

Mission mix: 54% interhospital, 33% scene runs, 13% other (neonatal, transplant, etc.). Average flight distance with patient: 50--52 miles. Air medical transport represents approximately 2% of all U.S. ambulance transports.

QUESTION 3

The primary staffing distinction between U.S. and European air medical programs is:

A. U.S. uses physician-led teams; Europe uses nurse/paramedic teams
B. U.S. uses nurse/paramedic teams; Europe uses specialist physician-led teams
C. Both use identical paramedic-nurse combinations
D. U.S. uses paramedic-only teams; Europe uses physician-paramedic teams

Answer: B

U.S. air medical programs primarily use nurse/paramedic teams. European and Japanese programs use specialist physician-led teams focused on delivering immediate specialist care on scene (often followed by ground transport to a local hospital rather than trauma center).

76 EMS Personnel

Key Legislation & Historical Framework

EMS Systems Act of 1973: first formal national initiative endorsing EMS in the U.S.; defined 15 components of an EMS system
EMS Agenda for the Future (1996): identified need for national consistency in EMS education, certification, and licensure
EMS Education Agenda for the Future: A Systems Approach (2000): called for five integrated national components (see Ch. 82)
National EMS Scope of Practice Model (2005, revised 2019): divides core content into four levels: EMR, EMT, AEMT, Paramedic

Four Levels of EMS (2019 Scope of Practice Model)

Level	Setting	Critical Thinking
EMR	Vocational	Protocol-driven, limited
EMT	Vocational	Protocol-driven + basic risk/benefit
AEMT	Vocational or Academic	Same + transport/resource decisions
Paramedic	Academic (diploma through bachelor's)	Same + highest complexity

Scope of Practice vs. Standard of Care

	Scope of Practice	Standard of Care
Core question	"Were you allowed to do it?"	"Did you do the right thing, properly?"
Legal consequence	Commission without license = criminal	Commission or omission → civil liability
Variability	Fixed by level; does not vary by circumstances	Situational; case-by-case
Defined by	Statute, rules, licensure board	Literature, expert witnesses, juries

The Regulatory Framework (Three Overlapping Layers)

National Certification: NREMT; assesses initial and continued competency nationally
Used for initial certification in 48 states at paramedic level (as of 2020)
Used for recertification in 30 states at paramedic level
State Licensure: legal authority to practice within the state; state-specific scope adjustments; disciplinary authority
Local Credentialing: performed by EMS agency leadership and medical director; addresses skills, protocols, and interpersonal competencies beyond entry-level

Key Definitions

Term	Definition
Licensure	Govt grants time-limited legal authority after verifying predetermined criteria; mandatory; title protection
Certification	(1) External competency verification (NREMT); (2) State credentialing (some states use this term); (3) Specialty post-licensure credential
Credentialing	Local agency process; authorizes EMS clinician to perform skills within that system under medical director oversight

Specialty Certifications

Community paramedic, critical care paramedic, flight paramedic, tactical paramedic/responder: no national standardized scope; handled state-by-state or via specialty organizations
Can be implemented as a credentialing role by the **local EMS medical director**

REPLICA

Recognition of EMS Personnel Licensure Interstate CompAct
Allows EMS clinicians to practice across state lines in participating states
20 states enrolled as of 2020

Regulation Principles

Occupational regulation is a **states' right** (U.S. Constitution)
Purpose: protect the public from incompetent, unscrupulous, or unethical practitioners

Regulatory boards owe loyalty to those *served by* licensees, not to the profession itself
Pew Commission recommends ≥ one-third public representation on professional boards
Discipline options: revocation, suspension, fines, consent orders, restitution, reprimand

PRIORITY PATCH

Scope of practice ≠ standard of care: acting outside scope = **criminal**; failing standard of care = **civil liability**
Three layers are complementary and none replaces the others: (1) NREMT national certification, (2) state licensure, (3) local credentialing; NREMT alone does NOT grant right to practice — the medical director's authority is most direct at the **credentialing layer**, the only layer under direct physician control
Scope of practice = fixed by level, does not vary by circumstance; standard of care = situational, defined by literature and juries
REPLICA: Recognition of EMS Personnel Licensure Interstate CompAct; allows practice across state lines in participating states (20 states as of 2020) — **state compact, not federal licensure**; individual states may still impose restrictions above the compact floor
Regulatory boards owe loyalty to those *served by* licensees, not to the profession; Pew Commission recommends ≥ one-third public representation on boards

⚡PULSE CHECK

QUESTION 1

Under the 2019 National EMS Scope of Practice Model, which level requires academic (diploma to bachelor's) education?

A. EMR
B. EMT
C. AEMT
D. Paramedic

Answer: D

Paramedic: academic (diploma through bachelor's) education, highest complexity clinical decision-making. EMR, EMT, and AEMT operate at vocational education levels. Paramedics engage in the same complex decision-making as AEMT plus the highest-complexity scenarios.

QUESTION 2

NREMT is used for initial paramedic certification in how many states?

A. 10 states
B. 32 states
C. 48 states
D. All 50 states

Answer: C

NREMT assesses initial and continued competency nationally and is used for initial paramedic certification in 48 states. State agencies set licensure requirements; NREMT provides the national certification mechanism.

QUESTION 3

Which of the following correctly describes the distinction between Scope of Practice and Standard of Care?

A. Scope is situational; standard is fixed by level
B. Scope = 'Were you allowed to do it?'; standard = 'Did you do it properly?'
C. Scope creates civil liability; standard creates criminal liability
D. They are the same concept with different terminology

Answer: B

Scope of Practice: 'Were you allowed to do it?' (defined by statute/rules --- fixed by level). Standard of Care: 'Did you do the right thing, properly?' (situational, case-by-case). Practicing outside scope = possible criminal liability. Commission/omission within scope below standard = civil liability.

77 Protection of EMS Personnel from Occupationally Acquired Infections

Regulatory Framework Overview

Body	Key Standard	What It Does
CDC	2007 Guideline for Isolation Precautions	Defines standard, airborne, droplet, contact precautions for all healthcare settings incl. EMS
OSHA	29 CFR 1910.1030 (1991); Needlestick Final Rule (2001)	PPE, engineering controls, HBV vaccine, sharps log
Ryan White Act (1990, updated 2009)	PL 111-87	Requires designated ICO, rapid post-exposure notification; COVID-19 added to list
NFPA 1582	Occupational medical program for fire depts	Fitness-for-duty, immunizations per CDC recommendations
NFPA 1581	Fire dept infection control program	Duties of infection control officer; practical infection control guidance

CDC Precaution Evolution

1985 Universal Precautions: addressed blood/body fluid exposures; first to include prehospital clinicians
1987 Body Substance Isolation: all moist body substances except sweat
1996 Standard Precautions: synthesis of above; added hand hygiene after every patient encounter
2007 Update: added respiratory hygiene/cough etiquette; expanded to all healthcare settings; addressed SARS, norovirus, MRSA; included bioterrorism Category A agents

Isolation Precaution Types

Type	Examples
Airborne	TB, measles, varicella
Droplet	Meningococcus, influenza, pertussis
Contact	MRSA, C. diff, enteric pathogens

Body Fluid Infectivity

OPIM (Other Potentially Infectious Material):
CSF, synovial fluid, pleural fluid, pericardial fluid, amniotic fluid
NOT considered infectious (unless visibly bloody):
Feces, nasal secretions, saliva, sputum, sweat, tears, urine, vomitus
Exception: saliva IS considered infectious in dental procedures (mucosal exposure) even without visible blood — OSHA-tested exam trap

Ryan White Act: Key Points

Requires each EMS agency to designate an **Infection Control Officer (ICO)**
Defines Emergency Response Employees (EREs): firefighters, LEOs, paramedics, EMTs, funeral practitioners, etc.
COVID-19 (SARS-CoV-2) added to list of reportable life-threatening infections
Two situations mandating hospital-initiated notification to ERE:
ERE believes exposure occurred
Hospital identifies listed infection in patient who was potentially infectious when cared for by ERE
Hospital must determine one of four findings: (1) exposed, (2) not exposed, (3) unknown/inconclusive, (4) insufficient facts

Blood-Borne Pathogen Management

Hepatitis B (HBV)
Risk reduced 98% (1983–2010) due to widespread vaccination
Vaccine: 3-dose series; check titers 1–2 months after 3rd dose
Responders: target anti-HBV ≥ 10 mIU/mL
Non-responders: repeat 3-dose series; retest; if still negative → counsel re: exposure risk; **HBIG** needed if exposed (≈71% protection)
HBV survives in dried blood for ≥ 1 week: counsel true non-responders carefully
Agencies must provide vaccine **free of charge**; workers must sign declination form before first patient contact if refusing

Hepatitis C (HCV)
No vaccine; no recommended PEP
Transmission rate: 0.2% percutaneous; 0.0% mucocutaneous (post-safety device era)
HCV infections tripled 2009–2018 (opioid crisis); age group 20–39 most affected
2020 CDC: screen all adults
Follow-up after exposure: HCV RNA at 3–6 weeks; anti-HCV at 4–6 months
If HCV RNA detected → refer per AASLD-IDSA guidelines; treat acute infection without waiting for spontaneous resolution

HIV
Risk: 0.3% percutaneous; 0.09% mucocutaneous splash
No vaccine, no cure
~13.8% of HIV+ persons in U.S. are undiagnosed; ~80% of new transmissions from people not in regular care
PEP indications: exposure to known or reasonably suspected HIV+ source
Start PEP ASAP (within hours); less effective if >72 hours post-exposure
Preferred regimen: **raltegravir (Isentress) + tenofovir/emtricitabine (Truvada)**
Duration: 4 weeks
Repeat labs at 2 weeks (CBC, renal, hepatic); HIV serology at 6 weeks, 12 weeks, 6 months
If source patient tests HIV-negative → discontinue PEP; no further HIV testing needed

Tuberculosis
M. tuberculosis: airborne transmission
Patients with suspected pulmonary TB → surgical mask during transport (if no respiratory compromise); crew wears **N-95 respirators**
Ventilation: set to **maximum non-recirculation** mode
TB risk assessment updated annually; drives respiratory protection program needs
TB cases declining but slowly; MDR-TB and XDR-TB present in U.S. but not more infectious than susceptible strains

Recommended Immunizations for EMS Personnel
Hepatitis B (3-dose series)
MMR (measles/mumps/rubella)
Varicella (if non-immune)
Tdap (single dose if not previously received; Td every 10 years after)
Annual influenza
COVID-19
TB screening per risk assessment
Travel vaccines as indicated (deployable teams)

COVID-19 (SARS-CoV-2)
First reported December 2019, Wuhan, China
Primary spread: airborne and droplet
SARS-CoV case fatality 9.7%; MERS-CoV 34%; SARS-CoV-2 lower CFR but more contagious
During pandemic: EMS activations ↓, scene deaths nearly doubled
Atypical presentations (syncope, falls, stroke, AMS, psychosis) → lower EMS suspicion → lower PPE use → higher clinician risk

Exposure Reporting
15–40% of clinicians exposed to blood-borne pathogens do NOT report as required
Common barriers: "lack of time," "low-risk patient"
ICO (not the clinician) determines whether exposure constitutes a risk
OSHA requires a sharps injury log; exposure report must comply with 29 CFR 1910.1030 and 1910.1020

PRIORITY PATCH

Many pathogens require **multiple simultaneous precaution types**; >50% of respiratory viral infections are asymptomatic at the time of EMS contact
HIV PEP: start within **72 hours**, run **4 weeks**, follow up at 6 weeks, 12 weeks, 6 months; preferred regimen: raltegravir + tenofovir/emtricitabine; **discontinue PEP if source patient tests HIV-negative**
HBV: vaccine gives 98% risk reduction; non-responders need **HBIG** if exposed; HBV survives in dried blood ≥1 week; agency must provide vaccine free of charge
HCV: **no vaccine, no PEP**; percutaneous transmission 0.2%; tripled 2009-2018 due to opioid crisis; screen all adults (2020 CDC)
Immunization is 50-60% less costly than post-exposure follow-up; 15-40% of exposed clinicians fail to report as required

⚡PULSE CHECK

QUESTION 1

The Ryan White Act requires which action after a potentially infectious patient exposure?

A. Automatic 14-day quarantine of the EMS provider
B. Rapid post-exposure notification from the receiving hospital's designated infection control officer
C. Mandatory HIV testing of the source patient within 24 hours
D. OSHA investigation within 72 hours

Answer: B

The Ryan White Act (1990, updated 2009, PL 111-87) requires a designated ICO and rapid post-exposure notification. COVID-19 was added to covered conditions. This enables EMS providers to know their exposure risk and seek appropriate post-exposure prophylaxis.

QUESTION 2

Which CDC precaution update (year) added respiratory hygiene/cough etiquette and addressed SARS, norovirus, and MRSA?

A. 1985 (Universal Precautions)
B. 1987 (Body Substance Isolation)
C. 1996 (Standard Precautions)
D. 2007

Answer: D

The 2007 CDC update expanded Standard Precautions, added respiratory hygiene/cough etiquette, addressed SARS/norovirus/MRSA, and expanded coverage to all healthcare settings including bioterrorism Category A agents.

QUESTION 3

OPIM (Other Potentially Infectious Materials) includes which body fluids?

A. Urine, feces, and nasal secretions
B. CSF, synovial fluid, pleural fluid, pericardial fluid, and amniotic fluid
C. Sweat, tears, and saliva only
D. All body fluids regardless of visible blood

Answer: B

OPIM: CSF, synovial fluid, pleural fluid, pericardial fluid, peritoneal fluid, amniotic fluid, semen, and vaginal secretions. Sweat is specifically NOT included. Saliva/nasal secretions are included only if visibly bloody.

78 Medical Surveillance of Emergency Response Personnel

Regulatory Framework

Regulation	Key Requirement
OSHA 29 CFR 1910.120	Medical surveillance program required (see triggers below)
EPA 40 CFR 311	Extends to govt volunteers (e.g., firefighters) and states lacking OSHA-approved plans
NFPA 1500	Occupational safety, health, and wellness
NFPA 1581	Infection control program
NFPA 1584	Rehab process during emergency operations

OSHA Triggers for Medical Surveillance Programs

Employees exposed to hazmat at or above Permissible Exposure Limits (PELs) for ≥ 30 days/year
Exposure above published levels in absence of PELs
Employees wearing respirator ≥ 30 days/year
Hazmat employees (plug/patch/control leaks)
Any employee injured from hazmat overexposure in an emergency

Goals of a Medical Surveillance Program

Early recognition of hazmat-related occupational disease
Early intervention and treatment
Effective management of occupational disease
Illness prevention

Program Structure

Led by occupational medicine physician (employee or contractor); must be licensed in state of operation
Records maintained throughout service + **minimum 30 years post-retirement/termination**
Responders entitled to access records **within 15 days** of request

Five Types of Medical Examinations

Exam Type	When
Initial employment	After conditional job offer (ADA-compliant)
Baseline	When assigned to specialty team with higher hazard exposure
Annual/periodic	Annually or biennially; repeats baseline except CXR
Exposure-specific	After any significant occupational exposure
Termination/exit	Upon job transfer, team exit, resignation, retirement

Initial Employment Exam Components

Vital signs (height, weight, BMI, BP, pulse, RR)
Chest X-ray
Pulmonary function tests (FEV, FVC, FEV/FVC)
Vision testing (corrected/uncorrected, color blindness, night blindness)
Auditory testing (500, 1000, 2000, 3000, 4000, 6000 Hz)
12-lead ECG ± stress test (age/finding dependent)
Blood chemistry: liver, kidney, electrolytes, glucose (if >120 → HbA1c), lipid panel, CBC
Urinalysis
Cancer screening (skin, colorectal)
Drug testing, pregnancy testing, cholinesterase, heavy metals (role-dependent)

On-Scene Medical Monitoring (Rehab)

Governed by **NFPA 1584** (updated 2021)
Rehab area functions: accountability log, PPE doffing, SCBA replenishment, medical triage, rehydration, monitoring
PPE should be removed before rehab entry (risk of off-gassing of VOCs)

EMS clinicians measure and record vitals on all personnel in rehab
2021 NFPA 1584: **abandons fixed vital sign parameters** in favor of experienced clinical judgment with reference to individual baselines
Electrolyte replacement: **evidence-based de-emphasis**
Daily acceptable caffeine limit: **400 mg/member**
Energy drinks: **NOT recommended** on or off duty (distinct from sports drinks)
Rest-work ratios: based on SCBA bottles used OR time worked without SCBA

Pre-Entry / Post-Entry Screening (Hazmat/PPE)

Pre-entry exam criteria: BP, pulse, RR, temp, O_2 sat vs. baseline; brief history; lung/heart sounds; skin inspection
Failure → rest 15–20 min → recheck → if still failing → reassign to non-PPE task
Post-entry exam: compare to pre-entry data; substantive changes require treatment per protocol

Exposure-Specific Exam

Triggered by any occupational exposure
Employer informed only of: (1) condition requiring follow-up, and (2) fitness-for-duty status
Worker's compensation paperwork coordinated by medical surveillance staff

PRIORITY PATCH

NFPA numbers: **1581** = infection control; **1582** = comprehensive occupational medical program (fire); **1583** = health and fitness; **1584** = rehab during emergency operations
OSHA 29 CFR 1910.120 triggers surveillance program: employees at/above PELs ≥30 days/year, wearing respirator ≥30 days/year, or injured from hazmat overexposure
Records maintained throughout service + **30 years post-termination**; employee access within **15 days** of request
Five exam types: initial employment, baseline (specialty team), annual/periodic *(repeats baseline **except CXR** — not repeated annually unless clinically indicated)*, **exposure-specific**, termination/exit
NFPA 1584 (2021): **abandoned fixed vital sign cutoffs** in favor of clinical judgment vs. individual baseline; energy drinks NOT recommended on or off duty

⚡PULSE CHECK

QUESTION 1

OSHA 29 CFR 1910.120 requires a medical surveillance program for hazmat employees exposed to hazardous materials at or above PELs for at least how many days per year?

A. 10 days
B. 20 days
C. 30 days
D. 60 days

Answer: C

OSHA triggers: employees exposed to hazmat at or above PELs for ≥30 days/year, wearing respirators ≥30 days/year, hazmat employees who plug/patch/control leaks, and any employee injured from hazmat overexposure in an emergency.

QUESTION 2

Medical surveillance records must be maintained for a minimum of how many years post-retirement?

A. 5 years
B. 10 years
C. 20 years
D. 30 years

Answer: D

Records maintained throughout employment and minimum 30 years post-retirement or termination. Responders entitled to access records within 15 days of request. Program led by occupational medicine physician licensed in state of operation.

QUESTION 3

Which type of medical examination is performed when a responder is newly assigned to a specialty team with higher hazard exposure?

A. Initial (pre-employment) examination
B. Baseline examination
C. Annual/periodic examination
D. Exposure/emergency examination

Answer: B

Baseline examination: performed when assigned to a specialty team with higher hazard exposure. Initial: after conditional job offer (ADA-compliant). Annual/periodic: annually or biennially. Exposure examination: after hazmat overexposure incidents.

79 EMS Clinician Wellness

Overview

Wellness = positive physical health + mental well-being
EMS clinicians face unique hazards: motor vehicle operation, violent patients, shift work, blood-borne pathogens, fatigue, burnout

Health Statistics

Indicator	EMS Data	General U.S. Population
Overweight/obese	71–80%	~40%
Tobacco use	15–21%	~18%
Physical inactivity	75% fail activity guidelines	~51% inactive
Self-rate health as poor	~1.8–10%	~5% (ages 18–44)

Relative risk of death: poor vs. good self-rated health = **2.9x**; fair vs. good = **1.6x**

Sleep & Fatigue

Recommended sleep: **7–9 hours/night** (National Sleep Foundation)
~1/3 of U.S. adults report inadequate sleep (<7 hrs)
Pittsburgh Sleep Quality Index (PSQI): score ≥6 = poor sleep quality; EMS mean ≈ 6.9–9.2
60–72% of EMS clinicians report poor sleep quality
Epworth Sleepiness Scale (ESS): ≥10 = excessive daytime sleepiness; **36% of EMS clinicians** score ≥10
Poor sleep linked to: workplace injury (OR 2.3), ambulance crashes, protocol memory difficulty, intent to leave profession

Fatigue

Definition: unpleasant symptom from tiredness to exhaustion that interferes with normal functioning
44–55% of EMS clinicians report severe mental and physical fatigue while at work
Fatigue linked to: increased injury risk (OR 2.9), medical error (OR 2.3), safety-compromising behavior (OR 4.9)

Shift Work

Any schedule other than standard daytime hours
Disrupts homeostatic and circadian sleep-wake regulation
>50% of EMS clinicians work >45 hrs/week; most work 12- or 24-hour shifts; 40% work >16 shifts/month
Up to **80% hold additional employment or work overtime**
Long-term consequences: cardiovascular disease, poor mental health, sleep problems persist into retirement

Work-Related Stress & Violence

Commonly reported stressors: high patient demand, shift scheduling, medically unnecessary calls, poor admin relationships, low pay
Up to 60–65% of EMS clinicians have been assaulted on the job
Outcomes of chronic stress: alcohol use, depression, burnout, turnover
Many clinicians do not recognize stress as affecting their performance

2018 Evidence-Based Guidelines: Fatigue Risk Management in EMS (5 Recommendations)

Use validated fatigue/sleepiness survey instruments to measure and monitor fatigue
EMS personnel work shifts **shorter than 24 hours**
EMS personnel have access to **caffeine** as a fatigue countermeasure
EMS personnel have the opportunity to **nap while on duty**
EMS personnel receive **education and training** to mitigate fatigue risks

PRIORITY PATCH

60-72% of EMS clinicians report poor sleep quality (PSQI ≥6); **36%** score ≥10 on Epworth Sleepiness Scale (excessive daytime sleepiness)
Fatigue links: injury risk OR 2.9, medical error OR 2.3, safety-compromising behavior **OR 4.9**; 44-55% report severe fatigue while at work
>80% of EMS clinicians hold additional employment or work overtime; >50% work >45 hrs/week; **shift work is an independent cardiovascular risk factor** of similar magnitude to traditional CV risks (not merely associated) — long-term consequences persist into retirement
2018 evidence-based fatigue guidelines: shifts **shorter than 24 hrs**, access to caffeine, opportunity to **nap on duty** (evidence-based despite cultural resistance in EMS), validated fatigue surveys, education/training
EMS overweight/obese: **71-80%** (vs. ~40% general population); 75% fail physical activity guidelines: wellness deficits are measurable and exam-tested

⚡PULSE CHECK

QUESTION 1

Approximately what percentage of EMS clinicians report poor sleep quality?

A. 20--30%
B. 40--50%
C. 60--72%
D. 80--90%

Answer: C

60--72% of EMS clinicians report poor sleep quality (Pittsburgh Sleep Quality Index score ≥6; EMS mean ≈ 6.9--9.2). Poor sleep is linked to workplace injury (OR 2.3) and ambulance crashes. 36% of EMS clinicians score ≥10 on the Epworth Sleepiness Scale (excessive daytime sleepiness).

QUESTION 2

EMS clinician fatigue is associated with which odds ratio for safety-compromising behavior?

A. OR 1.5
B. OR 2.3
C. OR 3.5
D. OR 4.9

Answer: D

Fatigue: safety-compromising behavior OR 4.9, increased injury risk OR 2.9, medical error OR 2.3. 44--55% of EMS clinicians report severe mental and physical fatigue at work. >50% work >45 hours/week.

QUESTION 3

Compared to the general U.S. population, the overweight/obesity rate in EMS clinicians is approximately:

A. Similar (~40%)
B. Higher (71--80%) vs. general (~40%)
C. Lower due to physical demands
D. Slightly higher (50--55%)

Answer: B

71--80% of EMS clinicians are overweight/obese vs. approximately 40% of the general U.S. population. Tobacco use, physical inactivity (75% fail activity guidelines), and poor self-rated health are also elevated compared to general population benchmarks.

80 Occupational Injury Prevention and Management

Occupational Fatalities

EMS fatality rate: **6.3 per 100,000 FTEs** vs. 4.0/100,000 for general working public
EMS fatality rate may be **>2.5 times** higher than general population (Maguire et al.)
76–86% of documented EMS fatalities linked to transportation (motor vehicle/aircraft)
Ambulance crashes: **>50% occur when crossing intersections**; majority in emergency mode (lights/sirens)
Drivers involved in crashes are at **increased risk for future crashes**; half have been in multiple crashes

Occupational Injuries (Non-Fatal)

Estimated 99,400 nonfatal injuries 2003–2007 requiring ED evaluation; 21,000+ in 2017 alone
Most common type: **sprains/strains (38%)**; contusions/abrasions (17%); lacerations/punctures (14%)
Most common body region: **neck and back (31%)**: consistent with lifting/moving patients
Rate of lost-work-time injuries: **highest in EMS** compared to fire and police (per workforce size)
~32% of injuries go unreported (stigma, perceived low severity)
~45% of EMS clinicians report injury in preceding 3 months (self-report data)

Ambulance Crash Risk

4–9% of EMS personnel have been in an ambulance crash
Serious/fatal injury risk: **2.5x higher for improperly restrained** vs. restrained occupants
Rear compartment: **nearly 3x more likely** to have serious/fatal injury vs. front — **largely exempt from federal motor vehicle safety standards**; this regulatory gap is the underlying explanation for the disparity
Few EMS clinicians wear seatbelts while providing rear compartment care
"Drivecams" (onboard event recorders): reduce high-G driving events over time; modify behavior
Ambulance crashes: **37% of all tort claims** against EMS agencies

Violence Against EMS Personnel

>60% of EMS clinicians assaulted while on the job (prospective studies)
65% in international surveys; weapons used in ~10% of incidents
EMS clinicians exposed to violent patient/event every ~19 calls
Few receive adequate training to respond to violence safely

Injury Prevention Strategies

Musculoskeletal (Back) Injury Prevention
Core strength and hip flexibility are key
Tight iliopsoas → reciprocal inhibition of gluteus maximus, transversus abdominus, multifidus → ↑ back injury risk
Powered ambulance stretchers reduce injury risk by >50% (one large urban study: 61.1 → 28.8 injuries per 100 FTEs)
Ergonomic focus areas: lateral transfers, bed-to-stair chair transfers, stair descent

Slips, Trips, Falls
1,700+ EMS clinicians treated in EDs for falls in 2017
Intrinsic risk factors: age, body mass, balance, fatigue, fitness
Extrinsic risk factors: equipment load, footwear, terrain
Asymmetrical load carriage (heavy bag on one shoulder) may alter gait and increase fall risk

Safety Culture
Poor workplace safety culture scores linked to higher injury rates across 5 of 6 domains measured
Culture of safety = shared beliefs about safety conditions, policies, and practices

Data & Measurement Challenges

No uniform national EMS injury database; makes comparison across systems difficult
Cumulative incidence rate = injuries per time period ÷ workers at start of period
Denominator problem: EMS workforce size is poorly documented (estimates 800,000–1 million)

PRIORITY PATCH

EMS fatality rate: **6.3/100,000 FTE** vs. 4.0 general public; 76-86% of documented EMS fatalities linked to transportation (MV/aircraft)
>50% of fatal ambulance crashes occur crossing intersections; majority in emergency mode; rear compartment is **3x more likely** to have serious/fatal injury than front (**largely exempt from federal vehicle safety standards** — the regulatory explanation for this disparity)
Ambulance crashes = **37%** of all tort claims against EMS agencies; drivers with prior crash are at increased risk for future crashes
Powered ambulance stretchers reduce musculoskeletal injury rate by **>50%**; most common EMS injury = sprains/strains (38%); most common region = neck and back (31%)
>60% of EMS clinicians have been assaulted on the job; ~32% of injuries go unreported; lost-work-time injury rate is **highest in EMS** vs. fire and police

⚡PULSE CHECK

QUESTION 1

The EMS occupational fatality rate compared to the general working public is:

A. Equal (4.0/100,000 FTEs)
B. 6.3/100,000 FTEs --- higher than general public
C. 10.2/100,000 FTEs --- more than double
D. 2.5/100,000 FTEs --- lower due to safety training

Answer: B

EMS fatality rate: 6.3/100,000 FTEs vs. 4.0/100,000 for the general working public (Maguire et al. suggest it may be >2.5× higher). 76--86% of documented EMS fatalities are linked to transportation. >50% of ambulance crashes occur at intersections.

QUESTION 2

The most common type of non-fatal occupational injury in EMS is:

A. Lacerations/punctures from sharps
B. Sprains and strains (38%)
C. Burns from equipment malfunctions
D. Contusions from violent patients

Answer: B

Sprains/strains (38%) are most common non-fatal EMS injury, followed by contusions/abrasions (17%) and lacerations/punctures (14%). Most common body region: neck and back (31%), consistent with patient lifting demands.

QUESTION 3

EMS clinicians working in the rear ambulance compartment have which relative risk of serious/fatal injury compared to the front cab?

A. Equal risk
B. 1.5× higher
C. Nearly 3× more likely
D. Lower risk due to protected enclosure

Answer: C

Rear compartment occupants are nearly 3× more likely to have serious/fatal injuries --- yet the rear compartment is largely exempt from federal motor vehicle safety standards. This regulatory gap is the primary explanation for the disparity. Few EMS clinicians wear seatbelts in the rear.

81 Prevention and Intervention for Psychologically Stressful Events

Background

EMS clinicians have routine exposure to objectively distressing events AND carry baseline occupational strain
PTSD and depression rates vary widely by study: rates appear higher than general population but study limitations abound
Job satisfaction in EMS is generally good despite stressors; intrinsic rewards are high

History: Critical Incident Stress Management (CISM)

CISM and Critical Incident Stress Debriefing (CISD) were dominant industry approach for decades
CISM programs were well-received as organizational support signals
However: little empirical evidence of efficacy for PTSD prevention; some studies show **paradoxical effects** (debriefing may impair natural recovery in some individuals)
Multiple authoritative guidelines (Cochrane, UK NICE, Australian PTSD guidelines) **caution against or contraindicate** routine CISM-style debriefing
CISM teams were typically peer-driven, insulated from organizational structures, minimal mental health qualifications

Current Recommended Approach: Stepped Care / Integrated Occupational Behavioral Health

NFPA 1500 (2013 revision) placed psychological response programs under **occupational health program** oversight, not standalone peer/EAP structures.

Four-Step Framework
Immediate assistance: proximal, non-intrusive, ecologically intact; stress first aid principles; increases accessibility, early identification
Early, non-intrusive assessment: most clinicians will NOT develop PTSD after difficult calls; watchful waiting + practical support; refer those with obvious distress
Stepped care: treatment matched to clinical need; basic EAP support for sub-threshold distress; specialty referral for clinical thresholds
Evidence-based treatment: trauma-focused cognitive behavior therapy (TF-CBT) with graded exposure; standard of care for clinical PTSD

PTE Protocol (Potentially Traumatic Event)

Experience PTE
Protocol request? (Does clinician consider it significant?)
Supervisor "Hot Wash" → Resolution achieved? → If yes: protocol ends
If not resolved: TSQ Screen (10-item questionnaire)
Score ≥ 6 → Complete behavioral health assessment → Specialist referral (TF-CBT)

Supervisor "Hot Wash"

Based on military after-action review
Should be **routine** after all calls, not just traumatic ones: this normalizes the practice
Five standard questions:
What happened?
What was successful?
What could have gone better?
How might we improve?
Who should we tell about what we learned?
Add when indicated: "How are you doing?" and "What can we do to support you?"

Trauma Screening Questionnaire (TSQ)

10 yes/no items; scored by counting positive responses
"Yes, at least twice in the past week" to:
Upsetting thoughts or memories of the event
Upsetting dreams about the event
Acting/feeling as if event is recurring
Feeling upset by reminders
Bodily reactions when reminded (fast HR, nausea, sweating, dizziness)
Difficulty falling or staying asleep
Irritability or anger outbursts
Difficulty concentrating
Heightened awareness of danger

Being jumpy or easily startled
Score ≥ 6 → refer for complete behavioral health evaluation
Score < 6 with distress → may still benefit from EAP referral

Treatment

Specialist referral (board-certified psychiatrist, doctoral-level psychologist, or certified clinical social worker)
TF-CBT with graded exposure: well-documented efficacy including for occupational PTSD — distinct from generic CBT; the trauma focus and graded exposure components are essential; non-trauma-focused CBT has relatively poor PTSD efficacy
Course: typically 12–25 sessions; may be complicated by co-occurring substance use, family issues
Many common non-trauma therapies are relatively ineffective for PTSD

Help-Seeking Preferences (Halpren et al.)

EMS clinicians prefer practical support: 30–60 min "time out" alone or with chosen peers after difficult calls
Supervisor expression of concern is valued
If professional intervention needed: clinicians want control over context and source

Organizational Resources

First Responder Center for Excellence (firstrespondercenter.org): National Fallen Firefighters Foundation
IAFF Behavioral Health (iaff.org/behavioral-health): peer support training, resources
Center for Firefighter Behavioral Health: MUSC (cffbh.org): online instruction in evidence-based treatment

Personal Wellness as Foundation

Resilience is built on the individual clinician's capacity to absorb stressful exposures
Annual behavioral health evaluations (ideally alongside medical evaluation) recommended: must be **confidential and non-punitive**
Screening domains: sleep, depression, anxiety, substance use, PTSD, social support, resilience, coping, satisfaction
IAFF/IAFC Joint Labor Management Wellness and Fitness Initiative: reference for comprehensive programs

PRIORITY PATCH

CISM/CISD: well-received but NOT evidence-based for PTSD prevention; Cochrane, UK NICE, and Australian guidelines **caution against or contraindicate** routine debriefing
Current standard: **Stepped Care** framework (NFPA 1500, 2013); most clinicians will NOT develop PTSD after difficult calls; watchful waiting + practical support first
TSQ screen: 10 yes/no items; **score ≥ 6** → refer for complete behavioral health evaluation; gold-standard treatment = **TF-CBT with graded exposure** (12-25 sessions) — *TF-CBT ≠ generic CBT*: trauma focus + graded exposure are the essential active components; generic CBT has poor PTSD efficacy
Supervisor "Hot Wash": based on military after-action review; should be **routine after all calls**, not just traumatic ones — normalizes the practice
EMS clinicians prefer: 30-60 min alone or with chosen peers after difficult calls; supervisor expression of concern is valued; control over context of professional intervention

⚡PULSE CHECK

QUESTION 1

Which authoritative bodies have cautioned against or contraindicated routine CISM-style debriefing?

A. NAEMSP, FEMA, and the Surgeon General
B. Cochrane, UK NICE, and Australian PTSD guidelines
C. ACEP, NAEMSP, and the APA
D. IOM, CDC, and SAMHSA

Answer: B

Cochrane reviews, UK NICE guidelines, and Australian PTSD guidelines cautioned against routine CISM-style debriefing --- some studies showed paradoxical effects (debriefing may impair natural recovery in some individuals). CISM lacked empirical evidence for PTSD prevention despite being well-received as an organizational support signal.

QUESTION 2

Per NFPA 1500 (2013 revision), psychological response programs for EMS should be placed under which structure?

A. Standalone peer/EAP structures
B. Occupational health program oversight
C. Direct chaplain/peer counselor network
D. External mental health contractor without agency integration

Answer: B

NFPA 1500 (2013 revision) placed psychological response programs under occupational health program oversight --- not standalone peer/EAP structures. The current recommended approach is stepped care/integrated occupational behavioral health.

QUESTION 3

The first step of the current four-step EMS psychological response framework is:

A. Formal structured debriefing within 72 hours
B. Immediate, proximal, non-intrusive assistance using stress first aid principles
C. Mandatory psychological evaluation for all responders
D. Peer debriefing with trained CISM team members

Answer: B

Step 1: Immediate assistance --- proximal, non-intrusive, ecologically intact; stress first aid principles; increases accessibility and early identification. The approach respects the responder's immediate needs rather than imposing formal structured debriefing.

82 EMS Practitioner Education

Medical Director's Role in Education

Every EMS medical director is an educator: by statute, by practice, and by example
NAEMSP/ACEP (1997, revised 2016 with NAEMSE) defined core physician roles:
Approve medical/academic qualifications of faculty and accuracy of medical content
Routinely review student performance; attest to competency prior to graduation
Participate in faculty selection and curriculum development; maintain authority over medical content

Theories of Adult Learning

1. Andragogy (Knowles, 1960s) — Self-Directed Learning
Adults and children learn differently. Six core principles:
Need to know WHY they are learning (not just what)
Self-concept: autonomy and self-direction; involve learner in planning and evaluation
Prior experience: builds on previous positive/negative learning
Readiness to learn: greatest when immediately relevant to work or personal life
Orientation: problem-centered, not subject-centered
Motivation: intrinsic as people mature

2. Social Learning Theory (Bandura; Miller & Dollard)
Learning by observational modeling + reinforcement
"**See one, do one, teach one**" is the EMS/medical application
Self-efficacy: belief in ability to complete tasks; sources: mastery experiences, social modeling, social persuasion, psychological state
Success ↑ self-efficacy; early failure ↓ self-efficacy disproportionately

3. Transformative Learning Theory (Mezirow)
Meaningful learning occurs by challenging existing **frames of reference** through critical reflection
Frames of reference components: cognitive (perception, knowledge), conative (drive, action), emotional (feelings, attitudes)
Educator's role: create safe environment; use activating events; foster openness to new perspectives

4. Context-Based Learning (formerly Problem-Based Learning)
Student-centered; organized around real-life scenarios
Originated at McMaster University (1960s) for medical education
Groups identify learning needs, research, and develop strategy to resolve scenario
Encourages critical thinking and lifelong learning skills

5. Experiential Learning (Dewey, Kolb)
Concrete experience → critical reflection → abstract conceptualization → active testing in future situations
Educator designs experiences and facilitates reflection

Language of Learning

Education Delivery Systems

System	Description
Traditional	Synchronous; same time, same place; teacher-centered
Distance education	Asynchronous; student-centered; different times/places
Hybrid/blended	Combines face-to-face with distance methods
Flipped classroom	Foundational content via distance (pre-class); in-class time for application (simulations, case studies)

Domains of Learning (Bloom's Taxonomy)

Domain	Description
Cognitive	Knowledge and thinking (remember → understand → apply → analyze → evaluate → **create**)
Affective	Attitudes, values, feelings
Psychomotor	Physical skills

2001 Anderson/Krathwohl revision: top level changed from "evaluation" to **"create"**

Learning Styles (VARK — Fleming, 1987)
Visual, Auditory, Reading/Writing, Kinesthetic
No evidence that matching teaching to preferred style improves outcomes
Best practice: teach using **variety of modalities** to engage all learners

History of EMS Education

1950s: American College of Surgeons first training programs
1967: American Academy of Orthopedic Surgeons: first EMT textbook (*Emergency Care and Transportation of the Sick and Injured*: the "orange book")
1970: First NREMT meeting to credential ambulance attendants
1971: First EMT curriculum delivered to NHTSA
1975: AMA recognized paramedics as allied health professionals
1977: First paramedic curriculum (NHTSA)
1996: EMS Agenda for the Future: 14 attributes for EMS future
2000: EMS Education Agenda for the Future: A Systems Approach: 5 components
2019: **EMS Agenda: 2050**: 6 guiding principles (adaptable/innovative, sustainable/efficient, socially equitable, safe/effective, integrated/seamless, reliable/prepared)

Five Components of the EMS Education System

Component	Lead Organization	Key Points
1. National EMS Core Content	NAEMSP + ACEP	Describes entire domain of out-of-hospital knowledge/skills
2. National EMS Scope of Practice Model	NASEMSO	Sets floor skills for each level; 2019 revision reviewed 5 PICO topics
3. National EMS Education Standards	NAEMSE	Competencies, clinical behaviors, depth/breadth of content
4. National EMS Program Accreditation	CAAHEP/CoAEMSP	Protects students; self + peer evaluation every 5 years; bookend #1
5. National EMS Certification	NREMT	Entry-level competency verification; 2-year registration; bookend #2

2019 Scope of Practice Model PICO Reviews

Use of opioid antagonists: **clear benefit → advance change notice (2017)** for all levels — issued before the 2019 model revision due to urgency of evidence
Therapeutic hypothermia in cardiac arrest
Pharmacologic pain management (trauma)
Hemorrhage control (tourniquets, wound packing): **clear benefit → advance change notice (2017)** — these two topics (opioid antagonists + hemorrhage control) are the only PICO items with pre-2019 advance notices
CPAP/BiPAP at EMT level

Accreditation (CAAHEP/CoAEMSP)

CoAEMSP: 14 sponsoring organizations (includes NAEMSP, ACEP, ACOOEP, AAP, ACS, NAEMSE, NAEMSO, NREMT, IAFC, IAFF, and others)
Only accredits programs ≥ 1 academic year (EMT/EMR programs not accredited under CAAHEP)
Process: self-study → site visit → compliance report → progress reports → re-review every 5 years; annual outcome data submission
As of 2013: paramedic candidates must graduate from CAAHEP-accredited program to take NREMT paramedic exam
As of publication: 638+ accredited paramedic programs; 79 seeking initial accreditation

Medical Direction Requirements for Accreditation (CoAEMSP Standards)

Responsibilities:
Review/approve curriculum content for accuracy and evidence-based practice
Review/approve minimum numbers for required patient contacts and procedures
Review/approve evaluation instruments
Review student progress; assist in corrective measures
Ensure graduate competency in cognitive, psychomotor, and affective domains
Ensure physician-student educational interaction
Qualifications:

Licensed physician with experience in emergency care of acutely ill/injured
Adequate training/experience in out-of-hospital care, medical direction, and QI
Active in local medical community
Knowledgeable about EMS education, legislative, and regulatory issues

Key Regulatory Terminology

Term	Definition
Certification	Non-governmental private agency (e.g., NREMT): based on competency standards; no practice authority by itself
Licensure	Legislative entity (state); grants permission to practice; autonomy in service delivery
Registration	List of individuals achieving a specific professional status (e.g., NREMT registry); prerequisite for licensure but does not grant practice rights
Accreditation	Non-governmental, independent, collegial process of self and peer assessment against standards

Skill Decay and the Case for Continuing Education

Skill decay (Latman & Wooley): basic skills decay to ~50% of baseline competency in EMTs and ~61% in paramedics **within 2 years** without reinforcement — the primary evidence base for structured CE requirements and Kirkpatrick Level 3–4 measurement
If skills decay this rapidly, Kirkpatrick Level 1–2 (reaction + knowledge test) are insufficient; Level 3 (field behavior) and Level 4 (outcomes) are required to verify retained competency

Continuing Education

Requirements vary by state, region, department
NREMT recertification requirements apply in states using NREMT for renewal
CAPCE (Commission on Accreditation for Pre-Hospital Continuing Education): national CE accreditor; allows credit across state lines and via distance education
Glick's model for evidence-guided education: correlates local outcome data with education priorities (errors, near misses, M&M conferences → targeted education → measurable practice improvement)

Evaluating Education (Kirkpatrick Model)

Level	Question	How Measured
1: **Reaction**	How did learners perceive the education?	Evaluation form ("smile sheet")
2: **Learning**	Were objectives met?	Skills assessment, quiz
3: **Behavior**	Are learners applying knowledge in the field?	Field observation, customer surveys, QI data
4: **Results**	Are agency outcomes improved?	Cardiac arrest survival, crash rates, injury rates

Remediation and Workforce Reentry

Remediation
Triggered by: failure to complete orientation/internship, clinical errors (medication misadministration, missed acuity, 12-lead interpretation errors)
Medical director meets with practitioner + supervisor + training designee
Discussion must include: identified deficiency, objectives, evaluation method, time frame, consequences of failure
SMART objectives: Specific, Measurable, Achievable, Realistic, Time-bound
Use Just Culture algorithm to determine if education-only or disciplinary pathway
Human resources must be involved

Workforce Reentry
For prolonged absences: illness, injury, maternity leave, military deployment
Begin after fit-for-duty clearance
Stepwise structure based on duration of absence (6 weeks vs. 6 months vs. >1 year)
Update certifications, refresh skills, learn new equipment/protocols
Military medical deployment → may justify abbreviated reentry

Evaluation
Must be consistent with organizational standards: not more stringent for remediation/reentry than for others
Methods: cognitive testing, practical scenarios, psychomotor skills, field observation, oral interview
Full documentation required; must be saved in employee file

PRIORITY PATCH

Andragogy (Knowles) = adult learning: self-directed, problem-centered, intrinsically motivated; Pedagogy = child-centered, teacher-driven: know the contrast
Five components of EMS Education Agenda: Core Content → Scope of Practice Model → Education Standards → **Program Accreditation (CAAHEP)** → **National Certification (NREMT)**; accreditation + certification are the "two bookends"
Kirkpatrick Level 4 (Results) = hardest to achieve; requires sustained multi-strategy effort + equipment + supervision + QI; one training session alone never achieves it
As of 2013: paramedic candidates must graduate from **CAAHEP-accredited program** to sit for NREMT paramedic exam; NREMT registration valid **2 years**
Bloom's taxonomy 2001 revision: top level = **"Create"** (not "Evaluation"); also changed **nouns → verbs** throughout (e.g., Knowledge → Remember; Synthesis → Create) — VARK learning styles: no evidence matching teaching to style improves outcomes

⚡PULSE CHECK

QUESTION 1

Which principle of Andragogy (Knowles) best distinguishes adult from pediatric learners?

A. Adults learn better through passive lecture
B. Adults need external authority to direct their learning
C. Adults are self-directed and learn best when content is immediately relevant to their work/life
D. Adults learn primarily through role model observation

Answer: C

Andragogy core principles: adults are self-directed, build on prior experience, are readiest to learn when content is relevant to work/life, and are intrinsically motivated. This contrasts with pedagogy (child learning) which is more externally directed.

QUESTION 2

Per NAEMSP/ACEP guidelines, the EMS medical director's educational responsibilities include:

A. Delivering all didactic content personally
B. Attesting to competency prior to student graduation
C. Testing students on clinical skills only
D. Delegating all educational activities to program coordinators

Answer: B

Medical director responsibilities include: approving faculty academic qualifications and accuracy of medical content, routinely reviewing student performance, attesting to competency prior to graduation, and participating in faculty selection with authority over medical content.

QUESTION 3

'See one, do one, teach one' is most closely associated with which adult learning theory?

A. Andragogy
B. Transformative learning (Mezirow)
C. Social learning theory (Bandura)
D. Deliberate practice theory

Answer: C

Social learning theory (Bandura; Miller & Dollard) emphasizes observational modeling + reinforcement. 'See one, do one, teach one' is the EMS/medical application. Self-efficacy comes from mastery experiences, social modeling, and persuasion.

83 Legal Issues

Overview

Medical oversight is legally unique: misunderstood by lawyers, the public, and even some physicians
Early EMS courts called ambulances "medical taxicabs" as recently as 1989
EMS medical directors were rarely named as defendants for the first 30 years; this trend is weakening
EMS became the 6th EM subspecialty in September 2010, raising the legal profile of the medical director

The Physician–EMT Legal Relationship

Relationship is **supervision**, not **agency**
Agency = employer/employee → respondeat superior ("let the master answer")
Supervision = medical director oversees practice but does not employ the EMT
EMTs are agents of their *employer* (the service), **not** of the medical director
"Delegated practice" is a legally incorrect term in most states: **Texas** is a notable exception where statute authorizes physician delegation
EMTs do **not** practice "under the physician's license": they practice under their own state licensure/certification, under physician *supervision*

Term	Meaning
License	Permission from a competent authority to perform an act otherwise illegal
Certification	Formal assertion of a fact (e.g., completed training)
Verification	Proof of education completion only (e.g., ATLS card)

The EMS clinician must answer to three distinct authorities: the supervising medical director, the employer, and the state licensing agency

Sources of the Medical Director's Authority

Two primary sources:
Statutes/regulations: highly variable by state - Some states (e.g., New Mexico) require notification to the licensing agency when medical supervision is withdrawn - Some states require board certification or completion of a medical director course (e.g., New Mexico: within 2 years of appointment)
Contractual provisions: critical when statutes are silent
Contract minimum provisions:
Clearly delineate responsibilities of both parties
Authority must match responsibilities (medical director must be in command of anything affecting patient care)
Identify to whom the medical director is accountable
Payment, duration, recourse for nonperformance
Insurance coverage details
Authority to participate in dispatch, equipment selection, all patient care decisions

Sources of Accountability

Federal Law
Sexual harassment: includes creation of a hostile work environment (not just overt acts)
HIPAA: protects past, present, or future health information in any form; EMS had to revamp recordkeeping and consent procedures
False Claims Act / Medicare fraud: signing ambulance medical necessity forms carelessly can expose a physician to civil penalties and FBI investigation; patient must demonstrate ALS need (abnormal vitals, medications) for ALS reimbursement
42 U.S.C. §1983 (Civil Rights Act): allows federal suit for constitutional rights violations
State immunity statutes do not apply in federal court
State damage caps do not apply
Successful plaintiff may recover punitive damages and attorney's fees
Professional liability insurance often does NOT cover civil rights suits
Key §1983 cases:
Doe v. Borough of Barrington (1990): failure to train police on AIDS confidentiality → civil rights liability
Wideman v. Shallowford Community Hospital: no constitutional right to transport to a hospital of patient's choice
Baxter v. Fulton-DeKalb Hospital Authority: paramedic had due process rights before medical director could refuse reinstatement

State Statutes and Regulations
State law determines the EMT–medical director link
Protocols must match each clinician's certification/training level
Medical directors are accountable to the state licensing board even without direct physician–patient relationships (see *Murphy v. BOMEX*)
Signing a form stating "I am legally and professionally responsible for the directed medical actions of this EMT" creates significant obligations

Local Ordinances
City ordinances and county resolutions may impose stringent, sometimes outdated requirements
Violations can lead to revocation of ambulance service permits
Medical directors giving orders conflicting with local laws create legal exposure

Immunity Laws

Type	Scope	Notes
Good Samaritan	Scene of emergency; gratuitous care in good faith	Varies by state; usually protects against ordinary negligence; does not protect gross negligence
Sovereign immunity	Government agencies/subdivisions	Requires gross or willful negligence to overcome; does not apply in federal court
EMS personnel immunity	Good faith acts; not reckless/grossly negligent	Cannot rely on this to shield clearly negligent conduct
Federal (FTCA)	Federal employees; discretionary functions protected	Non-discretionary care delivery is *not* protected
Aviation Medical Assistance Act (1998)	In-flight medical response	Protected unless gross negligence or willful misconduct

Areas of Liability
Two categories:
Professional: traditional medical malpractice (direct patient care oversight); covered by professional liability insurance
Administrative: employment decisions, withholding medical oversight, reimbursement issues; traditional malpractice insurance typically does NOT cover this
Legal theories of liability:
Failure to perform responsibilities: failure to create protocols, audit performance, provide oversight
Negligent supervision: failure to act on known deficiencies; must correct, restrict, or remove unsafe clinicians
Tallahassee Regional Medical Center v. Meeks: jury verdict against medical director for failure to supervise, train, and provide written protocols for pediatric assessment

Due Process Framework (Mathews v. Eldridge)
Due process is **flexible, not absolute**: "what process is due" depends on three factors: (1) private interest at stake, (2) risk of erroneous deprivation, and (3) government's interest in efficient administration
Not all procedural protections apply in every situation; courts apply this balancing test case-by-case
Due process applies only to *government action*: private employer discipline — however unfair — does not trigger constitutional due process
At-will employment = no property interest; fixed-term contract, tenure, or implied promise = property interest

System Concerns
Dispatch
Sovereign immunity and the "public duty" doctrine generally shield dispatch agencies
Special duty exception: if a special relationship forms (e.g., direct contact, reliance on dispatcher's promise of help), duty to specific individual may arise
Dispatch recordings containing PHI = medical records; not public record; HIPAA protections apply
Chicago asthma case: dispatcher failed to stay on line until crew arrived; crew failed to try unlocked door → sovereign immunity initially applied, then overturned

Response
Ambulance response must be timely; $2 million awarded in Honolulu for 2-hour delay
Volunteer services must meet the same minimum standards as paid services
Inappropriate staffing (sending first-aid-only personnel when EMTs were available) = willful/wanton conduct

Destination
Transport decisions must be based on medical necessity, not economics
Hospital Authority of Gwinnett County v. Jones: $1.3 million punitive damages for economically motivated transport decision
EMTALA: "coming to the emergency department" includes reaching hospital-owned ambulance

Failure to Transport / Patient Refusal
Non-transport management principles:
Understand this is the area of greatest liability for service and medical director
Know local and state law regarding patient rights and involuntary transport
Ensure adequate training in evaluating decision-making capacity
Protocols must be based on optimal care, not economics
Contact with direct medical oversight should be *true consultation*, not empty formality
Ongoing audit of radio reports, PCRs, and follow-up is essential
Review all use of restraints and involuntary transport
Release form reviewed by legal counsel before use
Informed refusal requires:
Patient has decisional capacity
Patient informed of diagnosis, recommended treatment, alternatives, likely consequences of refusal
Release documents: Limited legal protection; do not replace need for informed refusal; courts may reject as contrary to public policy.
Involuntary transport: May constitute false imprisonment or Fourth Amendment violation; requires legal authority (e.g., statute allowing transport in good faith). Medical oversight involvement may be evidence of good faith.

Interfacility Transfers
EMTALA governs: transfer must be "effected through qualified personnel and required transportation equipment"
Medical director must ensure only adequately trained crews accept transfers
Billing fraud for non-ambulatory patients billed as requiring ambulance = Medicare fraud and abuse

Documentation
PCR is the best defense against malpractice
Sloppy, incomplete PCRs = poor system image before a jury
PCR is also justification for billing; exaggeration of patient condition = Medicare fraud
Medical director should have final authority in all patient care incident reviews

Equipment
Medical director should exercise authority in equipment selection and implementation
Require skills check-off with any new equipment or procedure
Remove hazardous or ineffective equipment
"Be neither the first nor the last to use a new medication or procedure"

Summary Principles
Medical directors who serve only by signature face the greatest legal risk
Active, informed, involved medical directors are significantly less vulnerable
Key liability triggers: failure to provide protocols, failure to discipline, failure to implement QI audits
Every radio contact between physician and field clinician = potential liability

PRIORITY PATCH

EMTs practice under their **own state license**, not under the physician's license; the physician provides supervision, not agency (employer relationship)
Highest-risk area for EMS liability: nontransports and patient refusals; informed refusal requires decisional capacity + disclosure of diagnosis, treatment, alternatives, and consequences
§1983 (Civil Rights Act): bypasses state immunity entirely; state damage caps do not apply; punitive damages + attorney fees recoverable; most malpractice policies do **NOT** cover §1983 claims; requires a **"state actor"** — private EMS may escape liability unless operating under color of state law (e.g., exclusive franchise, government contract)
State "certification" that grants the *right to practice* functions legally as a **license** and carries due process protections regardless of terminology
EMS cannot diagnose but **does** evaluate decision-making capacity; "A&O ×3" alone is insufficient for this evaluation

⚡PULSE CHECK

QUESTION 1

The correct legal term for the relationship between an EMS medical director and paramedics in most U.S. states is:

A. Agency --- director as employer, paramedic as agent (respondeat superior)
B. Supervision --- director oversees practice but does not employ the EMT
C. Delegation --- paramedics practice under the physician's license
D. Employment --- director is legally the employer of all prehospital clinicians

Answer: B

The relationship is supervision --- the medical director oversees practice but does not employ the EMT. EMTs are agents of their employer (the service). 'Delegated practice' is legally incorrect in most states (Texas is a notable exception). EMTs practice under their own state licensure.

QUESTION 2

In EMS credentialing, 'certification' is correctly defined as:

A. Permission from a competent authority to perform an otherwise illegal act
B. A formal assertion of a fact (e.g., completed training)
C. Proof of education completion only
D. External inspection confirming standards are met

Answer: B

Certification = formal assertion of a fact (e.g., completed training). License = permission to perform an act otherwise illegal. Verification = proof of education completion only. These three terms are legally distinct.

QUESTION 3

Early EMS courts characterizing ambulances as 'medical taxicabs' reflected which misunderstanding?

A. Belief that EMS was purely transportation with no medical liability
B. Misunderstanding of EMT scope as equivalent to physician practice
C. Belief that EMS medical directors had unlimited liability
D. Misunderstanding of the Hippocratic Oath's application to paramedics

Answer: A

Early courts (as recently as 1989) treated ambulances as purely transportation services without medical liability --- a fundamental misunderstanding of EMS as medical practice. EMS medical directors were rarely named as defendants for the first 30 years, but this trend is weakening.

84 Legislation, Regulation, and Ordinance

Brief History

Year	Milestone
1966	*Accidental Death and Disability: The Neglected Disease of Modern Society*: foundation of organized EMS
1969	First DOT curriculum for EMT-Ambulance
1970	National Registry of EMTs (NREMT) established
1973	EMS Systems Act: federal support for state EMS systems
1996	EMS Agenda for the Future: vision of community-based health management integrated with health care
2010	NASEMSO Model Statutory and Regulatory Content for State EMS Systems published
2020	EMS Agenda 2050: roadmap for further integration

The Role of Legislation: Patient Protection

EMS patients cannot choose their provider at time of crisis (unlike primary care)
Patients open their homes to strangers, share sensitive information, may be incapacitated
EMS delivers high-risk interventions with no advance notice → public interest in conservative regulation
Physician oversight role is a **public protection responsibility**

Terminology

Term	Definition	Examples
Statute (law, code)	Created by elected legislature; broad language	Federal or state EMS act
Rule (regulation)	Created by state agency under statutory authority; more detailed; subject to public input	Scope of practice rules
Ordinance	Municipal/local law; created under authority delegated by state statute	Response time requirements, vehicle specs
Contract	Agreement between parties for compensation for services	Private EMS service contract with a county
Policy	Internal agency requirements for daily operations	Agency standard operating procedures

Key Principle: No lower-level authority may conflict with a higher-level authority: Federal statute > State statute > State regulation > Ordinance.
Ease of modification (easiest to hardest): Local agency policy → Local ordinance → State rule → State statute → Federal statute

Incorporation by Reference

Strategy for embedding external standards into statutes/rules without reopening the legislative process
Example: EMS Education Agenda for the Future: states that incorporated it by reference automatically adopt updates without legislative action
Risk: if the external document is not updated, incorporated standards become stale — creates **regulatory lag** in some states
Has five components: core content, scope of practice model, education standards, national certification, national program accreditation
Most states now require NREMT certification for licensure; paramedic programs must be CoAEMSP-accredited

State EMS Statute Components (Broad Authority)

System leadership, organization, regulation, and policy
System financing
Human resources: education, certification, licensure
Transportation by ambulance services
Regionalization of facilities and specialty care
Public access and communications
Public information, education, prevention
Clinical care and medical oversight

System evaluation and research
Large-scale event preparedness

Federal Laws Affecting EMS

Law	Relevance
HIPAA	Patient privacy in all EMS records and communications
EMTALA	Governs interfacility transfers; hospital-owned ambulances trigger EMTALA on pickup
OSHA 1910.120	Hazmat safety standards protecting EMS workers
Medicare Claims Processing Manual, Ch. 15	Ambulance billing and reimbursement rules
Fair Labor Standards Act (1938)	Wage, hour, and overtime requirements: affects EMS shift configurations; **§7(k) partial exemption** allows public safety EMS a longer work period before overtime kicks in — commonly tested in finance/staffing questions

Future Directions

ET3 (Emergency Triage, Treat, and Transport) CMS pilot: reimburses EMS for treatment in place and transport to alternative destinations; requires state-level Medicaid and insurance changes

REPLICA: Interstate compact for EMS personnel licensure portability; 20+ states enrolled at time of writing

PRIORITY PATCH

1966: Highway Safety Act (created DOT/NHTSA) + NAS "Accidental Death and Disability" white paper — same year, different purposes
1973 EMSS Act: first comprehensive federal EMS approach; defined 15 required components; first federal funding
1981 Omnibus Budget Reconciliation Act: ended direct federal EMS funding; shifted to block grants
1984 EMSC (Emergency Medical Services for Children) authorized; **1996** EMS Agenda for the Future — introduced community-integrated health management vision (**MIH/CP conceptual origin**); **2010**: ABEM recognized EMS as 6th EM subspecialty
Authority hierarchy (easiest to hardest to change): local policy → local ordinance → state rule → state statute → federal statute; lower authority cannot conflict with higher

⚡PULSE CHECK

QUESTION 1

What distinguishes a 'rule' (regulation) from a 'statute' (law) in EMS governance?

A. Rules are created by elected legislatures; statutes by administrative agencies
B. Statutes are created by elected legislatures (broad language); rules are created by state agencies under statutory authority (more detailed)
C. Rules require legislative approval; statutes do not
D. Statutes apply only federally; rules apply only at state level

Answer: B

Statute (law/code) = elected legislature, broad language. Rule (regulation) = state agency under statutory authority, more detailed, subject to public input. Ordinance = municipal/local law. Policy = internal agency requirements.

QUESTION 2

Why do EMS patients warrant conservative regulatory oversight compared to other healthcare settings?

A. EMS patients are older with more comorbidities
B. EMS patients cannot choose their provider at time of crisis, open their homes to strangers, and may be incapacitated
C. EMS is funded primarily by public tax dollars
D. EMS clinicians have less training than hospital-based providers

Answer: B

EMS patients cannot choose their provider at time of crisis, open their homes to strangers, share sensitive information, and may be incapacitated. EMS also delivers high-risk interventions with no advance notice. This public vulnerability creates the rationale for conservative regulation.

QUESTION 3

EMS Agenda 2050 was published in which year with what primary focus?

A. 1996 --- 14 attributes of ideal EMS
B. 2006 --- EMS as community-based health management
C. 2019 --- people-centered vision with 6 guiding principles
D. 2010 --- ABEM subspecialty recognition framework

Answer: C

EMS Agenda 2050 was published in 2019 with a people-centered vision and 6 guiding principles. The 1996 EMS Agenda for the Future identified 14 attributes. The 2006 IOM report led to ABEM subspecialty recognition in 2010.

85 Due Process

Overview

"Due process of law" = federal constitutional principle giving every person the right to present reasons why the government should not deprive them of life, liberty, or property
Dramatically expanded by *Goldberg v. Kelly*, 397 U.S. 254 (1970): recognized due process right to notice and hearing before termination of welfare benefits
Applies to: employment terminations, licensure/certification actions, disciplinary proceedings, withdrawal of medical authorization/credentialing, and QI reviews

Sources of Due Process Law

Federal hierarchy:
Supreme Court of the United States → binding on all
U.S. Courts of Appeals (11 numbered + DC + Federal Circuit) → binding in their circuits
U.S. District Courts (94) → primarily bind the specific case
State: Each state has its own court hierarchy; state administrative procedures acts govern most EMS disciplinary proceedings

Two Components of Due Process

Type	Description
Substantive due process	Prevents government from engaging in conduct that "shocks the conscience" or interferes with fundamental rights
Procedural due process	Requires fair process before depriving someone of life, liberty, or property

To establish substantive due process violation:
Challenged action affects a fundamental right, OR
Substantial infringement prompted by personal or group animus, OR
Government action is legally irrational (not related to any legitimate state interest)

Elements of Procedural Due Process (Friendly's List)

Identified by Judge Henry J. Friendly, listed in relative order of importance:
Unbiased tribunal
Notice of the proposed action and grounds asserted
Opportunity to present reasons why proposed action should not be taken
Right to call witnesses
Right to know the evidence against you
Right to have decision based only on evidence presented
Right to counsel
Record of the proceeding
Statement of reasons for action taken

Governmental Action Requirement

Procedural due process **only applies to government action**
Private conduct is NOT covered, no matter how unfair
Three tests for whether private party = state action:
Public function test: entity exercises powers traditionally exclusively reserved to the state
State compulsion test: state exercises coercive power or provides significant encouragement such that the private actor's choice is effectively the state's
Symbiotic relationship/nexus test: sufficiently close nexus between state and the challenged action
For EMS: Volunteer and private ambulance companies, private ambulance companies, and medical directors can all be found to be engaging in state action depending on facts → due process then required.

Medical Directors and Due Process

A medical director of a state-created hospital ambulance service has been found to be engaged in state action
If state law requires an ambulance service to have a medical director, the medical director's actions may be state action
Rubin v. Fox: medical director's withdrawal of paramedic medical authorization held invalid: failed to follow regulatory process, inadequate investigation, untimely written notice

Medical directors themselves may be entitled to due process depending on the nature of their contracts

Medical Review Committees

Valuable tool for QA/QI and disciplinary investigations
Proceedings are confidential under many state statutes
Because they function under state statutes, they ARE viewed as state action and ARE subject to due process
Exact due process required is not always specified; guidance available from the Healthcare Quality Improvement Act of 1986

Life, Liberty, or Property Interests

Interest	Description
Life	Limited to capital cases
Liberty	Freedom from bodily restraint; right to pursue occupation; damaged when employment action affects ability to obtain other employment
Property	Arises when there is an entitlement under state law (license, contract, implied promise of continued employment); must not be discretionary

Liberty interest in employment: Arises when an action is taken that *stigmatizes* the employee AND damages their ability to find other work (e.g., charges of immorality, dishonesty, alcoholism, incompetence) — **not any adverse action qualifies**; the stigmatizing + reputational harm to future employability are both required
HIPDB (Healthcare Integrity and Protection Data Bank): established 2000 under HIPAA; state and federal agencies must report licensure actions; reporting may NOT raise a due process liberty interest per some courts
Property interest in employment:
At-will employment → NOT a property interest
Contract for fixed term, tenure, implied promise of continued employment → property interest
An EMT license is a valuable personal right: cannot be denied or revoked except after due notice and fair hearing before an unbiased tribunal
Progressive discipline:
3-day suspension → likely no due process interest
5-day suspension → may raise a due process interest
Probation → may require procedural due process
Transfer with no pay change → generally not a deprivation
Warning or letter of reprimand without loss of rank/pay → probably not due process

Key Procedural Requirements

Notice
Must reasonably apprise the clinician of the proceedings
Must include: grounds for proposed action, type of action, the clinician's rights
Must state ALL facts/circumstances: additional incidents cannot be introduced at the hearing
Proof of delivery is essential (hand delivery with affidavit; certified/registered mail with signed receipt)

Timing of Hearing
Hearing should ordinarily occur **before** deprivation of a protected property interest
Exception: when public health, safety, or welfare is significantly at risk, summary action may occur first IF a prompt post-deprivation hearing is available
Rinehart v. City of Greenfield: hearing where no evidence was heard about the validity of the medical director's withdrawal of privileges was not a "meaningful hearing"

Standard of Proof
Beyond a reasonable doubt: criminal standard; not generally applicable to administrative proceedings
Preponderance of the evidence: more likely than not; sufficient for most medical disciplinary proceedings
Clear and convincing evidence: some courts require this higher standard for medical proceedings

Right to Counsel
No constitutional right to counsel in administrative proceedings
Government not obligated to provide counsel (unlike criminal proceedings)
Prohibiting counsel is not recommended: its absence may create due process violation if it impairs fundamental fairness of the hearing

PRIORITY PATCH

Due process applies only to **government action**; private conduct is not covered regardless of how unfair
Two types: substantive (government cannot "shock the conscience" or infringe fundamental rights) vs. procedural (fair process before deprivation)
Due process is **flexible**: what process is due depends on (1) private interest at stake, (2) risk of erroneous deprivation, (3) government's interest in fiscal/administrative efficiency
Withdrawal of medical authorization without following regulatory process = invalid (*Rubin v. Fox*); hearing must include actual evidence to be "meaningful" (*Rinehart*); **notice must state ALL grounds at the outset** — additional incidents cannot be introduced at the hearing; adding new charges at hearing = procedural invalidity of the entire proceeding
At-will employment = no property interest; fixed-term contract, tenure, implied promise of continued employment = property interest; liberty interest requires **stigmatizing action that damages ability to find other work** — not any adverse action; EMT license = valuable personal right requiring notice and fair hearing

⚡PULSE CHECK

QUESTION 1

Which Supreme Court case dramatically expanded due process rights by recognizing the right to notice and hearing before termination of welfare benefits?

A. Roe v. Wade (1973)
B. Goldberg v. Kelly (1970)
C. Mathews v. Eldridge (1976)
D. Brown v. Board of Education (1954)

Answer: B

Goldberg v. Kelly, 397 U.S. 254 (1970) expanded due process by recognizing the right to notice and hearing before termination of welfare benefits. This framework now applies to EMS employment terminations, licensure actions, disciplinary proceedings, and withdrawal of medical authorization.

QUESTION 2

Substantive due process prevents government from:

A. Failing to provide fair procedure before depriving someone of liberty
B. Engaging in conduct that shocks the conscience or interferes with fundamental rights
C. Discriminating based on protected class characteristics
D. Making decisions without legislative authorization

Answer: B

Substantive due process prevents government from engaging in conduct that 'shocks the conscience' or interferes with fundamental rights --- regardless of the procedural safeguards used. Procedural due process requires fair process (notice, hearing) before depriving someone of life, liberty, or property.

QUESTION 3

Due process rights in EMS apply to which actions?

A. Voluntary resignation from an EMS agency
B. Withdrawal of medical authorization/credentialing
C. Performance improvement plans without suspension
D. Annual performance evaluations

Answer: B

Due process applies to: employment terminations, licensure/certification actions, disciplinary proceedings, withdrawal of medical authorization/credentialing, and QI reviews that could lead to adverse employment action. Voluntary resignation and routine evaluations do not trigger due process protections.

86 Risk Management

Overview

Risk: objective or subjective probability that something negative will occur
Internal components: safety, training, health and wellness, personnel management, equipment readiness
External components: prevention programs, public education, perception of the public

Components of Prehospital Risk Management

Risk Assessment
Classify by **frequency** and **severity**
High-frequency, high-risk activities require the most monitoring
Two activities every service should closely monitor:
Advanced airway procedures (low frequency, high risk)
Non-transported patients (high frequency, high risk)
Strategies:
Pre-loss: effective protocols/guidelines, thorough initial and continuing education with timely feedback, good documentation, QI program
Post-loss: well-crafted investigation, behavior-protocol comparison, remediation/education

Initial Training
Solid foundation of knowledge, skills, and attitudes
Medical director should be aware of quality of primary training institutions
If course medical director ≠ EMS medical director → communication between them is essential

Pre-Employment Screening and Orientation
Written examination, skills testing, physical agility testing, interviews, psychological screening, background checks
New employees: field orientation covering administrative, operational, and clinical areas (protocols, equipment, performance standards) before independent function
Field training officer should be approved by the medical director

Medical Supervision
Medical director directly responsible for patient care standards, protocol development, approval of scope of care
Medical director should be involved in the design and oversight of the risk management program

Continuing Medical Education (CME)
Skills decay is real: 50% of basic skills lost within 2 years for EMTs; 61% for paramedics (Latman & Wooley, 1980)
CME roles: protocol updates, knowledge review, new technology, ongoing skills evaluation, feedback forum
Medicolegal education within CME can reduce litigation (Goldberg, 1990)

Documentation
Non-transport calls require documentation as detailed as any transported call
PCRs submitted to Medicare → false entries = Medicare fraud (False Claims Act, 42 USC §1320)
Electronic PCRs create a specific legal risk: unchecked boxes default to "not done" — may be clinically inaccurate and legally damaging; medical director should proactively audit ePCR design to prevent default-to-negative errors
Medical director should proactively develop good PCR formats and discourage inadequate forms

Quality Management and Risk Management
Quality management identifies actual or potential risks → proactive management
Continuous action loop: starts and ends with protocols and education
5 steps of an effective risk management program:
Identify risk exposure
Evaluate risk potential
Rank and prioritize risks
Determine and implement control actions
Evaluate and revise actions as needed

Patient Expectations
Patients expect to be treated with dignity and that their welfare is the principal concern
When expectations are not met → anger → litigation

Patient Care Incident Management

Major categories of alleged negligence (Bowers 1992):

Alleged Negligence Categories (Bowers 1992)

Category	% of Cases
Treatment and care	42.85%
Ambulance accidents	40.1%
Dispatch and transport	27.47%
Training, staffing, administrative	2.52%

Patient care incident: any situation in which there is a concern or complaint regarding patient care: by commission or omission, by any participant

Establishing a Comprehensive Mechanism

Components: incident identification → investigation → findings → indicated actions → documentation → system effects

Incident identification sources:

Patient or family verbal/written complaint
Equipment failure identified by crew
Difficult patient encounter (prolonged extrication, etc.)
QI review findings (e.g., waveform capnography compliance)
Risk management trend analysis

Serious/critical incidents: must be reported immediately; chain of command must include the medical director

Incident Investigation

Uniformly applied, prearranged mechanism
Documents all interactions
Use of investigation checklist ensures consistency
Personnel responsible for investigation must be trained in this role
Respond promptly to complaints: many can be resolved with education
Crew members must have opportunity to respond verbally and in writing (due process)
All materials (tape transcripts, PCRs) must be collected
Patient privacy must be maintained throughout
Medical director must have **final authority** on evaluation of clinical aspects

Investigation findings may reveal:

Environmental influences, safety factors, training gaps
Employee clinical performance or behavior
Judgment error
Equipment deficiency or failure
Documentation issues
Patient expectation mismatches
Protocol or policy problems
Direct medical oversight involvement

Root Cause Analysis (RCA)

Goal: determine what happened, scope of the problem, how to prevent recurrence
Exposes system-linked issues rather than simply blaming individuals
Must analyze: all factors involved, systems and processes, contributing factors, best method(s) of correction
Supports a **"just culture"**: balances open, honest reporting with accountability for choices

Indicated Actions

Administrative actions: personnel actions per HR guidelines **Medical actions:** policy/protocol revision, product changes, remedial education, corrective measures

Remedial education options:
Classroom education
Clinical hospital education
Testing
Supervised field preceptorship
System-wide CME

Medical director has final authority on medical actions in response to patient care incidents.

Future Directions: Medical Error in EMS

National Academy of Medicine (1999): 44,000–98,000 Americans die from medical errors annually
Little literature exists specifically on prehospital medical error
Standardization (dispatch protocols, patient care protocols, equipment consistency) is a powerful error-reduction tool
"Total quality management requires a culture in which errors and deviations are regarded not as human failures but as opportunities to improve the system": Leape

PRIORITY PATCH

Two highest-risk activities to monitor: **advanced airway procedures** (low frequency, high risk) and **non-transported patients** (high frequency, high risk)
Skills decay is real: **50% of basic skills lost within 2 years** for EMTs; **61%** for paramedics (Latman & Wooley)
Properly completed PCR = best defense against malpractice; non-transport calls require documentation as detailed as transported calls; **ePCR-specific risk: unchecked boxes default to "not done"** — clinically inaccurate and legally damaging; medical director must audit ePCR format design
Root cause analysis: exposes system-linked issues rather than individual blame; supports "just culture" — balances open reporting with accountability
Medical director has **final authority on *clinical* aspects** of any patient care incident investigation — administrative/HR disciplinary actions are coordinated with HR, not unilaterally directed by the medical director

PULSE CHECK

QUESTION 1

Which two EMS activities have been identified as requiring the most monitoring due to their risk profiles?

A. IV access and medication administration
B. Advanced airway procedures and non-transported patients
C. Scene triage and spinal motion restriction
D. Cardiac monitoring and defibrillation

Answer: B

Advanced airway procedures (low frequency, high risk) and non-transported patients (high frequency, high risk) are the two activities every EMS service should most closely monitor. Non-transported patients are especially high risk because outcomes cannot be observed after EMS leaves.

QUESTION 2

Pre-loss risk management strategies in EMS include:

A. Well-crafted incident investigation and remediation after adverse events
B. Effective protocols, thorough initial/continuing education, documentation standards, and QI programs
C. Legal representation for providers involved in adverse events
D. Post-incident debriefing and peer support programs

Answer: B

Pre-loss strategies (before adverse events): effective protocols, thorough education with timely feedback, documentation standards, and QI programs. Post-loss strategies (after adverse events): investigation, behavior-protocol comparison, and remediation/education.

QUESTION 3

Field training officers for new EMS clinicians should be approved by:

A. The state EMS office
B. The union representative
C. The EMS medical director
D. The HR department independently

Answer: C

Field training officers should be approved by the medical director. New employees complete field orientation covering administrative, operational, and clinical areas before independent function. The medical director should be aware of the quality of primary training institutions.

87 Politics and Advocacy for the EMS Physician

Overview

EMS physicians operate at the intersection of medicine, politics, economics, and public safety
Technical expertise alone is insufficient: political acumen must be developed, usually through mentorship
System development follows a "reggae rhythm," not a measured waltz: non-linear, anything but smooth

Power Blocs in an EMS System

Local government (mayor, city council, county commissioners)
Chief EMS administrator (fire chief, EMS chief)
Hospital systems/administrators
Line personnel (firefighters, EMS clinicians)
Unions
Patients and taxpayers
State health department/EMS office/regulators
Payers (insurance, Medicaid, Medicare)
Regional subspecialty systems (trauma, stroke, etc.)
Visualize power blocs as **political vectors**: the goal is to align them as parallel as possible toward the desired EMS agenda.

Five Political Senses Requiring Mastery

Sense of mission: yours, the specialty's, and the institution's; physician is a "steward" with a fiduciary responsibility to the patient
Sense of tradition: know the community's history to navigate around existing political obstacles
Sense of position (*most tested of the five*): EMS is technically within emergency medicine, operationally within public safety, and philosophically within public health; must relate to all three worlds simultaneously — exam questions ask which "world" a given EMS function belongs to
Humor: invaluable throughout a career
Timing: new ideas should take advantage of other changes already in motion

Advocacy

Definition: The act or process of supporting a cause or proposal (Merriam-Webster)
Legislative/regulatory advocacy: Efforts to influence introduction, enactment, or modification of legislation and rulemaking
Most EMS policy decisions are **apolitical** (not party-driven): driven by available knowledge
Responsible advocacy fills the knowledge gap for decision makers
Traditional advocacy ("lobbying"): Educate decision makers about specifics of an issue; during official duties: **fundraising is strictly prohibited**

Case Study: Protecting Patient Access to Emergency Medications Act (2017)
DEA's Controlled Substances Act of 1970 required all orders for controlled substances to be "patient-specific": standing orders for narcotics were arguably illegal
NAEMSP partnered with Holland & Knight (government relations firm) and Rep. Hudson (NC)
Collaborated with ACEP and NAEMT, mobilized membership for "EMS on the Hill" day
First attempt failed; reintroduced with Sen. Cassidy sponsoring in Senate
H.R. 304, 115th Congress: signed into law: standing orders for controlled substances now legal

Case Study: Post-9/11 Advocacy (AEMS)
After 9/11, federal preparedness funding excluded EMS (EMS not in definitions)
Dr. Richard Hunt (NAEMSP president) identified the problem via Congressional contact
Founded **Advocates for EMS (AEMS)**: a coalition of EMS organizations including NAEMSP, NASEMSO, NAEMT
Small victories in grant language and report language; eventually sunsetted as running "association of associations" proved difficult
Legacy: NAEMSP and NAEMT now have permanent advocacy presences in Washington, DC

Political Action Committees (PACs)

Purpose: Raise money and contribute to federal election campaigns/committees
Corporations and trade organizations (NAEMSP, NAEMT, ACEP) **cannot** donate directly to candidates
Separate Segregated Fund (SSF): created as separate entity; serves as the PAC; only solicits from members; operates with full transparency: all donations declared publicly
Individual donation limit: $5,000 annually per person (2020 FEC limit)
PACs identify legislators with legislative histories or backgrounds likely to support EMS issues

Principles of Action for Medical Directors

Understand "political judo": use principles of medicine as leverage, not political constituency loyalty
Before pushing the first domino, know where the last one falls
Covet identified problems: complaints are "opportunities in drag"
Identify all stakeholders: internal and external; never ignore anyone in the system
Project academic passion with political neutrality
Visible power is vulnerable power: seek a low-profile but formalized power base
Apply the OREO analysis: **O**pportunities, **R**esources, **E**xpectations, **O**bstructions
Develop language skills: precision, brevity, elegance
5 spheres for achievement: academic, operational, administrative, clinical, community relations

PRIORITY PATCH

PAC (Political Action Committee): corporations and trade organizations (NAEMSP, ACEP) **cannot** donate directly to candidates; operate via a Separate Segregated Fund; all donations publicly declared
Individual PAC donation limit: **$5,000/year** per person (2020 FEC); PAC identifies legislators with EMS-friendly legislative histories
PPAEMA (2017): legalized standing orders for controlled substances; key advocacy win led by NAEMSP + Holland & Knight + Rep. Hudson (NC)
AEMS (Advocates for EMS): post-9/11 coalition (NAEMSP, NASEMSO, NAEMT) formed after EMS was excluded from federal preparedness funding definitions — key lesson: EMS was excluded because the **statutory definitions** didn't include EMS; advocacy must target definitions, not just funding levels
OREO analysis: **O**pportunities, **R**esources, **E**xpectations, **O**bstructions — framework for political action planning
Sense of position = most tested of the five political senses: EMS is *technically* in EM, *operationally* in public safety, *philosophically* in public health — must navigate all three worlds simultaneously

⚡PULSE CHECK

QUESTION 1

Which of the five political senses is most directly tested on the EMS board exam, describing EMS as simultaneously within emergency medicine, public safety, and public health?

A. Sense of mission
B. Sense of tradition
C. Sense of position
D. Sense of timing

Answer: C

Sense of position is most tested: EMS is technically within emergency medicine, operationally within public safety, and philosophically within public health. The EMS physician must relate to all three worlds. Board questions ask which 'world' a given EMS function belongs to.

QUESTION 2

Visualizing power blocs as political vectors, the goal of EMS physician advocacy is to:

A. Identify which blocs to oppose
B. Align blocs as parallel as possible toward the desired EMS agenda
C. Determine which bloc has the most financial resources
D. Isolate and neutralize opposing forces

Answer: B

Power blocs (government, administration, hospitals, unions, providers, patients, regulators, payers, regional systems) should be aligned as parallel as possible toward the desired EMS agenda. EMS system development follows a 'reggae rhythm' --- non-linear, requiring political skill.

QUESTION 3

Which statement best describes the EMS physician's role in advocacy?

A. Technical medical expertise alone is sufficient for EMS system leadership
B. Political acumen must be developed alongside medical expertise, usually through mentorship
C. The EMS physician should remain politically neutral
D. Advocacy is only relevant for EMS physicians on legislative committees

Answer: B

Technical expertise alone is insufficient --- political acumen must be developed, usually through mentorship. The physician is described as a 'steward' with fiduciary responsibility to the patient, operating at the intersection of medicine, politics, economics, and public safety.

88 Dispatch

Public Safety Answering Points (PSAPs)

Primary PSAP: receives calls directly from the public in a specific geographic region
Secondary PSAP: receives calls transferred from a primary PSAP; may handle a specific agency (e.g., EMS only)
Key technology:
CAD (Computer-aided dispatch): core software system
ALI (Automatic Location Identifier): displays caller's address/location
ANI (Automatic Number Identification): displays caller's telephone number
As most calls now originate from wireless phones, ALI/ANI is largely obsolete; geolocation is improving
MDT (Mobile data terminal): on-board unit receiving dispatch information, building floor plans, hazards
Next Generation 9-1-1 (NG-911):
Already implemented in several U.S. states and Canada
Accepts texts, video, and other data in addition to voice calls
Will integrate wearable medical devices, car computers, building alarms
AACN (Advanced Automatic Crash Notification): onboard vehicle system that detects crashes, sends detailed data to PSAP, predicts injury probability

Emergency Medical Dispatch (EMD)

History:
EMD Historical Milestones

Year	Milestone
Mid-1970s	Identified lack of medical training in dispatch = weakest link in EMS chain of survival
1977	Dr. Jeff Clawson begins developing scripted dispatch protocols
1978	Medical Priority Dispatching introduced at Salt Lake City Fire Department
Early 1980s	DOT releases national EMD curriculum

Early myths debunked: dispatchers can obtain information from excited callers; non-medically trained personnel can safely provide CPR and choking instructions
Failure to provide prearrival instructions is now viewed as potentially negligent
Modern EMD program components:
Systematized caller interrogation
Call prioritization with preassigned response levels and modes
Medically directed prearrival instructions
Telecommunicators = "the first, first responders": active medical oversight is required

Essential Components of an EMD System

Medical oversight
Prompt identification of time-sensitive emergencies with rapid dispatch
Call prioritization with preassigned response levels and modes
Scripted telephone prearrival instructions
Proper initial education, certification, and ongoing CME for telecommunicators
Active quality improvement process
Integrated process to reduce lights & sirens responses

Anatomy of an EMD Program

Entry/First Card Protocol
Gather: location (verify!), nature of emergency, number sick/injured, patient age, sex
Is patient awake? → proceed to chief complaint card
Is patient breathing normally? → if No or Unknown → **immediate dispatch** → proceed to CPR prearrival instructions

Chief Complaint Protocols
Symptom-based (abdominal pain, chest pain), diagnosis-based (stroke), or traumatic (gunshot, fall)
Drill down questions help determine response configuration and mode
Each generates a "determinant" linked to a predesignated response configuration

Caller categories:
EMD Chief Complaint Protocol Categories

Category	Description
First party	The patient (calling about themselves)
Second party	Someone with/near the patient; can relay info and perform instructions
Third party	Passerby; limited info, not on scene
Fourth party	Another public service agency or alarm company; often no direct patient info

Post-Dispatch Instructions
Basic: put pets away, gather medications, turn on outside lights
Complaint-specific: "don't let patient eat or drink" for abdominal pain

Prearrival Instructions (Dispatch Life Support)
Traditional: CPR, choking, AED use, childbirth
Recent additions: tourniquet use, epinephrine autoinjector, aspirin for ACS
Dispatcher-Assisted CPR (DA-CPR): significantly increases bystander CPR rates and OHCA survival
Compression-only DA-CPR instruction increases bystander performance
EMD accuracy data:
Cardiac arrest recognition: median sensitivity **73.9%** (range 14.1–96.9%): highly heterogeneous
Stroke identification with stroke tool: sensitivity **86.4%**, specificity **26.6%** (low specificity)

Lights and Sirens (L&S)

Study Finding	Key Data
Time saved with L&S (Hunt, 1995)	Average **43.5 seconds**
Urban time savings	~3 minutes
Calls NOT using L&S on response (2015 NEMSIS)	23.5%
Calls NOT using L&S on transport (2015 NEMSIS)	73.3%
"Wake effect"	L&S vehicles cause secondary collisions in their wake

MPDS recommends "cold" (no L&S) response for Charlie-level calls; many systems override this
Telecommunicator should be authorized to upgrade or downgrade response based on new information
The local jurisdiction: not the EMD program alone: determines "hot" vs. "cold" response

Quality Improvement
Active medical oversight of EMD QI is an essential component
Telecommunicators must ask questions and read instructions word-for-word as written
Noncompliance → inaccurate call prioritization, missed life-threatening conditions, lost opportunities for prearrival instructions
QI tools:
Cardiac arrest quotient: (# cardiac arrests confirmed by EMS on scene) ÷ (# responses generated by that code): codes with high quotient may need more robust response
4×4 matrix: dispatch priority vs. EMS disposition: identifies over-triage (waste of resources) and under-triage (treatment risk)
Linking dispatch data with ePCR data: most robust QI (Sporer et al.): 15% reduction in L&S responses while maintaining appropriate high-priority response

PRIORITY PATCH

Cardiac arrest calls: dispatch **immediately after location confirmed**; gather additional info after dispatch; delay in activating DA-CPR worsens outcomes
#1 reason cardiac arrest missed at dispatch: **agonal breathing** ("making funny noises"); telecommunicators must recognize irregular snoring as arrest, not normal breathing
EMD cardiac arrest sensitivity: median **73.9%** (range 14-97%); stroke identification sensitivity **86.4%** but specificity only **26.6%** — most positive stroke flags are **false positives**; resource implication for pre-notification protocol design
L&S saves average **43.5 seconds**; 2018 analysis: 85.8% of calls used L&S but only **6.9%** involved potentially life-saving interventions
Telecommunicators = "the first, first responders"; active medical oversight of EMD QI is an essential component; 4×4 matrix identifies over- and under-triage
Failure to provide prearrival CPR instructions is now viewed as potentially negligent — DA-CPR is a medical *standard of care* for telecommunicators, not optional guidance; a telecommunicator who fails to provide CPR instructions when indicated may expose the agency to liability

⚡PULSE CHECK

QUESTION 1

What is the functional difference between a primary PSAP and a secondary PSAP?

A. Primary handles 911 from cell phones; secondary handles landlines
B. Primary receives calls directly from the public; secondary receives transferred calls and may handle a specific agency
C. Primary handles ALS dispatch; secondary handles BLS
D. Primary is county-level; secondary is state-level

Answer: B

Primary PSAP: receives calls directly from the public in a geographic region. Secondary PSAP: receives transferred calls, may handle a specific agency (e.g., EMS only). CAD (computer-aided dispatch) is the core software system.

QUESTION 2

Next Generation 9-1-1 (NG-911) differs from Enhanced 9-1-1 (E9-1-1) by:

A. Providing automatic location data for wireless phones
B. Accepting texts, video, and other data in addition to voice calls
C. Requiring mandatory caller verification
D. Routing calls based on caller's medical history

Answer: B

NG-911 accepts texts, video, pictures, and integrates wearable devices, car computers, and building alarms --- in addition to voice. E9-1-1 adds location data for landlines, wireless phones, and VOIP. NG-911 is already implemented in several U.S. states and Canada.

QUESTION 3

EMD scripted dispatch protocols were first introduced by Dr. Jeff Clawson beginning in which decade?

A. 1960s
B. Mid-1970s
C. 1990s
D. 2000s

Answer: B

Dr. Jeff Clawson began developing scripted protocols in 1977; Medical Priority Dispatching was introduced at Salt Lake City Fire Department in 1978. The DOT released the national EMD curriculum in the early 1980s. Prior to this, lack of medical training in dispatch was the weakest link in the EMS chain.

89 Ambulance Safety

Epidemiology

Statistic	Value
Transportation-related EMS occupational fatalities (2003–2018)	**76.5%** of all EMS occupational fatalities
Annual EMS transportation-related fatalities	4–17 per year
Average fatal ambulance crashes per year (NHTSA, 1992–2011)	**29** crashes, **33** fatalities
Annual non-fatal ambulance crashes	~1,500
Ambulance crash casualty rate vs. national average	**Twice** as many casualties per crash
Proportion of EMS lawsuits related to crashes	**37–72%**

Urban vs. rural: More crashes in urban environments, but greater severity in rural environments

Contributing Factors: Haddon's Matrix

Factor	Pre-Event	Event	Post-Event
Human/Host	Fatigue, driver training, hearing impairment, substance abuse, distractions, stress	Proper restraint use, speed	Severity/type of injury
Vehicle/Agent	Maintenance, design, tire pressure, lack of restraints, lack of airbags	Protruding objects, sharp corners, equipment securement	Hazardous materials presence; ability of doors to open
Environment	Road conditions, urban/rural location, agency policies, support for research	Road banking, guardrails, rumble strips	Availability of emergency personnel, trauma centers

Key Contributing Factors

Fatigue

21 hours of wakefulness = impairment equivalent to **0.08% BAC** (Arnedt et al.)
Legal commercial driver alcohol limit: **0.04%**
3.6× greater odds of safety-compromising behavior in fatigued EMS workers (Patterson et al.)
48% of paramedics admitted nodding off or falling asleep while driving in one survey
85.9% of large U.S. EMS systems used 24-hour shifts (JEMS 2012 survey)
Employer responsibility for fatigue-related crashes may extend **after the shift ends** (Oregon, West Virginia precedents — post-shift commute crashes found employer liable): shared responsibility between employee and employer does not end at clock-out
Neal Sherman case: 25-year-old paramedic killed when partner fell asleep at wheel after working overnight at volunteer fire department
Evidence-based fatigue management (Patterson et al. 2018):
Assess and monitor fatigue with validated survey instruments
Shift length <24 hours whenever possible
Provide caffeine access throughout shifts
Incorporate on-duty naps
Educate on fatigue risk management
Shared responsibility between employee and employer

Driver Training

Programs range from short orientation to 40+ hours
Limited published evidence on efficacy
Simulator training and formal programs may reduce crashes
Graduated driving responsibility policies may help

Passenger Restraint

Seatbelt use in patient compartment is low:
87% of EMS personnel wore seat belt ≤40% of time during patient care (2013 survey)
Even in forward-facing seats with no patient, use was only 59.8%
Restrained ambulance occupants significantly less likely to be killed or seriously injured
Most states do NOT require patients of any age to be restrained in ambulances

Distractions
Multiple radios, computer, warning system controls: in addition to all standard vehicle controls
Distractions account for 20–30% of passenger car crashes (NHTSA)
Consider policies minimizing tasks assigned to the ambulance driver beyond safe vehicle operation

Lights and Sirens (L&S)
Disproportionate percentage of crashes occur during L&S operations
Analysis of 6 million calls (2018): 85.8% used L&S; only 6.9% involved potentially life-saving interventions
NAEMSP/NASEMSD (1994) joint position: recognized risks of L&S use
Time savings are minimal and rarely clinically significant

Vehicular Design
Ambulance front compartment regulated by Federal Motor Vehicle Safety Standards
Rear compartment is exempt: aftermarket modification, least regulated, most dangerous area
Equipment must be secured to resist 3-dimensional 10 G forces (recommendation from crash testing)
No federal requirement to follow any ambulance design standard
Sharp corners and protruding objects (oxygen nipples, IV poles) must be addressed

Driving History
71% of emergency vehicle drivers in crashes had prior emergency vehicle crash histories (Custalow & Gravitz)
Regular driving record checks recommended (not just at hire)

The Four Es of Injury Prevention

E	Approach
Education	Workforce training, fatigue awareness, risk communication
Engineering	Electronic monitoring, improved vehicle design, equipment tie-downs
Economics	Incentives for safer behaviors
Enforcement	Policies on speeding, safe driving, restraint use, driver behavior monitoring

Recommendations by Factor
Fatigue: shared employee-employer responsibility; shifts shorter than 24 hours; validated fatigue assessment tools
Driver training: research-supported programs; simulator training; graduated driving privileges
Restraints: engineering solutions (better rear compartment restraints); automated warning systems when personnel unrestrained; strong agency policy with enforcement
L&S: tiered dispatch protocols to reduce hot responses; education of all stakeholders; research linking L&S to clinical outcomes
Vehicular design: multi-stakeholder partnerships (agencies, manufacturers, engineers, government); international design alternatives should be studied
"Black box" monitoring: real-time feedback on speed, acceleration, seatbelt use; shown to dramatically reduce unsafe driving conditions and maintenance costs
Every EMS agency should have an ambulance safety officer responsible for:
Comprehensive data collection
Historical risk tracking
Setting improvement goals
Developing and testing interventions
Working with state, national, and international groups on best practices

PRIORITY PATCH

Greatest burden of serious injury/death in ambulance crashes: people **NOT in the ambulance** (pedestrians, other vehicles); most serious occupant injuries occur in the **patient compartment**
21 hours of wakefulness = impairment equivalent to **0.08% BAC**; legal commercial driver limit is 0.04%; 48% of paramedics admitted nodding off while driving; **employer liability may extend after shift ends** (OR/WV precedents: post-shift commute crashes)
Rear compartment is **exempt from federal FMVSS**; no federal requirement to follow any ambulance design standard; equipment must resist 10G forces in 3 dimensions
71% of emergency vehicle drivers in crashes had **prior crash histories**; regular driving record checks recommended (not just at hire)
Four Es: Education, Engineering, Economics, Enforcement; engineering + enforcement are more effective than education alone for seatbelt compliance
Haddon's Matrix = organizing framework for ambulance safety interventions — classify any intervention by *phase* (pre-event/event/post-event) and *factor* (host/vehicle/environment); exam questions use this matrix to classify specific safety measures

⚡PULSE CHECK

QUESTION 1

21 hours of wakefulness produces impairment equivalent to what blood alcohol content?

A. 0.04% BAC
B. 0.06% BAC
C. 0.08% BAC
D. 0.10% BAC

Answer: C

21 hours of wakefulness = impairment equivalent to 0.08% BAC (Arnedt et al.). The legal commercial driver alcohol limit is 0.04%. This means sleep-deprived EMS providers exceed the legal impairment threshold. 48% of paramedics have admitted nodding off while driving.

QUESTION 2

Compared to national averages, ambulance crashes have which casualty rate?

A. Similar to average crashes
B. Half the rate due to safety equipment
C. Twice as many casualties per crash
D. Three times the casualty rate

Answer: C

Ambulance crashes have twice as many casualties per crash vs. the national average. More crashes occur in urban areas, but rural crashes are more severe. 37--72% of EMS lawsuits are related to crashes. >50% of ambulance crashes occur while crossing intersections.

QUESTION 3

Haddon's Matrix applied to ambulance safety examines factors across which dimensions?

A. Driver, vehicle, and environment --- each at pre-event, event, and post-event phases
B. Speed, weather, and road conditions --- each in daytime and nighttime scenarios
C. Training, equipment, and policy --- across initial and continuing education phases
D. Provider, patient, and bystander --- at scene, transport, and hospital phases

Answer: A

Haddon's Matrix: host (driver/human), agent (vehicle), and environment --- each across three time phases: pre-event (before crash), event (during crash), and post-event (after crash). This framework identifies interventions at each intersection.

90 Communications

Historical Context

EMS Act of 1973 (P.L. 93-154): communications identified as 1 of 15 critical components of EMS; brought VHF and UHF radios to ambulances

2012: Middle-Class Tax Relief and Job Creation Act (P.L. 112-96): created **FirstNet** with $7 billion to build a nationwide public safety broadband network

COVID-19 pandemic: dramatically expanded EMS use of telehealth; CMS relaxed many telehealth restrictions

The EMS Communications System Must Support

System readiness/access/demand management

Dispatch

Patient interaction and collaboration with medical oversight

Access and Demand Management

Universal 9-1-1 access throughout the U.S.

Basic 9-1-1: voice + caller phone number display

Enhanced 9-1-1 (E9-1-1): adds location data for landlines, wireless phones, VOIP

Next Generation 9-1-1 (NG 9-1-1): accepts texts, video, pictures; integrates automatic vehicle notifications (OnStar), home alert systems, medical monitoring devices, smartphones

Information communications technology efficiency tools:

Mobile data computers

System status management

Vehicle locator systems (now commonplace)

Demand management: Communications system with medical oversight can navigate patients to services beyond ambulance transport to ED: including community paramedicine, telehealth, urgent care, behavioral health

Dispatch

Ideally one PSAP per EMS system with trained telecommunicators

Centralized dispatch benefits: saves money, manpower, equipment vs. individual community centers; minimizes delays in coordinating scene responses; especially near jurisdictional borders

Caveat: centralization is often politically charged ("turf" issue); many systems that resisted consolidation now outsource remotely to save costs

Field Clinician–Medical Direction Communication

Direct medical oversight best provided by experienced EMS physicians immediately available for guidance

Centralized model: single resource hospital "base station" → notifies receiving facility of patient condition and estimated arrival

Traditional LMRS-based oversight: VHF, UHF, or 700/800 MHz

Cellular/smartphones: increasing role; offer more privacy; are not always recorded by communications center (liability issue)

Best practice: dial communications center and patch to ED, so call is recorded

Evolution of direct medical oversight:

Now allows multimedia exchange: simultaneous audio, video, data

Single transmissions can pack all patient information, unpacked automatically at hospital

Multichannel/multi-carrier devices can automatically select strongest available signal

Telemedicine in EMS (2020 JEMS report):

Potential to enhance quality of care by decreasing time to definitive care, informing destination decisions, increasing diagnostic accuracy

Majority of surveyed EMS clinicians would welcome it

Top benefits cited:

Physician-assisted critical care (64%)

Risk management: patient refusal scenarios (60.5%)

Improved decision support/community paramedicine (57.3%)

Severe injury: MVC trauma (81.4%), stroke assessment (81%), pediatric asthma (79.5%)

Barriers: lack of broadband coverage, intrusive equipment, audio/video quality, care workflow interruption

Current Communications Infrastructure

Land Mobile Radio Systems (LMRS)

Traditional foundation: VHF and UHF frequencies

Includes newer 700/800-MHz trunked systems
All systems: redundancy and flexibility must be engineered in
Transition from analog to digital: calls now "drop" suddenly rather than fading — in rural/marginal coverage areas, crews may lose contact without warning; unlike analog fade (gradual degradation gives notice), digital drop is abrupt; **critical patient safety implication for medical oversight communications**

VHF Radio

Frequency	Historical Use
155.340 MHz	Ambulance-to-hospital or administrative/dispatch (called "VMED28")
155.400 MHz	Ambulance-to-hospital
155.175 MHz	Ambulance-to-hospital
155.280 MHz	Hospital-to-hospital (largely fallen to other uses)

Best for: frontier, rural, suburban EMS: longest range
Simplex: one-way at a time ("you talk, then I talk")
Range depends on: power output, antenna height, repeater placement

UHF Radio
"MED channels": 10 paired frequencies in 463- and 468-MHz ranges
Best for: urban: better building penetration than VHF
Full duplex: two-way simultaneous conversation
Shorter range than VHF; requires repeaters or microwave systems for extended range
Tone-coded squelch ("private line/PL"): Minimizes radio noise for unintended recipients; does NOT prevent interference from other transmissions on same frequency

700/800-MHz Trunked Systems
FCC designates 806–809 MHz and 851–854 MHz for trunked systems
Computer automatically searches for open frequency: prevents manual selection and reduces congestion
Limitation: shorter range; more towers needed for rural areas = significantly higher rural cost
Vehicular repeaters allowed: portable radio can reach nearest tower via ambulance

Cellular/Wireless Phones
Common in EMS: privacy advantages; smartphones add photo/data/internet capability
Disadvantages: network overloading during disasters, no one-to-many broadcast capability, typically not recorded by communications center
Solution: patch through communications center for recording
Priority access: Cybersecurity and Infrastructure Security Agency coordinates priority services for emergency response agencies

Evolving Infrastructure

Multiband and Software-Defined Radio (SDR)
Multiband radios: access to VHF, UHF, 800 MHz, 4.9 GHz, FirstNet, satellite, commercial wireless in one device
Cognitive/software-defined radios: scan channels for availability; automatically switch to best-strength frequency across multiple bands; field clinician may not know which band is being used

FirstNet — Nationwide Public Safety Broadband Network
Created by: Public Law 112-96 (Middle-Class Tax Relief and Job Creation Act, February 2012)
What it provides:
Dedicated 700-MHz broadband spectrum for public safety
$7 billion to build the network
First Responder Network Authority (FirstNet) Board with public safety advisory committee (includes EMS representative)
Partnership with AT&T to build and operate on a self-sustaining basis
Why it matters for EMS:
Enables real-time transmission of: multi-vital signs, capnography, ECG, pulse ox, portable ultrasound, video, point-of-care test results
Provides situational awareness: automatic vehicle/equipment location, public safety GPS routing, hospital bed status, patient medical history
Prioritized/preemptive access over general public
Three approaches: terrestrial network, satellite supplement (for rural/frontier), deployable systems (special events, disasters)
Technology: Long Term Evolution (LTE): international standard; mission-critical voice capabilities (push-to-talk, one-to-many, device-to-device) still evolving; until fully mission-critical voice capable, LMRS remains the primary voice platform

Patient Care Records

Paper PCR → electronic PCR (ePCR) → NEMSIS-compliant data systems
NEMSIS: National EMS Information System: standardizes data dictionary across states
ePCR increasingly integrated into hospital electronic health records (EHR) and health information exchanges (HIE)
Field clinicians can access patient medication records, ECG trends, medical history via HIE in real time
Relevance to communications: ePCR is both a legal record and a real-time communication tool between EMS and hospital

Communications Planning Resources

DHS Emergency Communications Division (ECD) and SafeCom: guidance on planning, interoperability
National Emergency Communications Plan (NECP): national framework
Statewide Communications Interoperability Plans (SCIP): each state should have one, coordinated by a statewide interoperability coordinator
National Public Safety Telecommunications Council (NPSTC): federation of public safety associations; advocates before FCC; develops best practices; has EMS working group co-hosted with NASEMSO Communications Committee
SafeCom Interoperability Continuum: five lanes of development (technology is only one):
Governance
Standard operating procedures
Technology
Training and exercises
Usage

PRIORITY PATCH

FirstNet: created by PL 112-96 (2012); $7 billion; dedicated 700-MHz broadband for public safety; partnered with AT&T; enables real-time ECG, video, vitals, ultrasound transmission
Interoperability is **not primarily a technology problem**: SafeCom continuum requires governance, SOPs, technology, training/exercises, and daily usage — technology is only one of five lanes
Best practice for cellular medical direction calls: patch through communications center so the call is recorded; direct cellular calls to ED typically are NOT recorded
NG-911: accepts texts, video, pictures; integrates wearables, OnStar, building alarms; already implemented in several states and Canada — will eventually accept data from **wearable and implanted cardiac devices**, transforming 9-1-1 from a reactive to a potentially **proactive** emergency response system
VHF = vast range, rural/suburban, simplex; UHF = urban (building penetration), full duplex, shorter range; 800 MHz = trunked, urban, computer-selects channel, most limited rural range
Digital radio drops suddenly (vs. analog fade with warning) — abrupt loss of contact in marginal coverage areas; critical patient safety implication; plan for redundancy in rural systems

⚡PULSE CHECK

QUESTION 1

The Middle-Class Tax Relief and Job Creation Act of 2012 created which nationwide public safety communications infrastructure?

A. Enhanced 9-1-1 (E9-1-1)
B. FirstNet broadband network
C. Next Generation 9-1-1 (NG-911)
D. National EMS Communications System

Answer: B

P.L. 112-96 (2012) created FirstNet with $7 billion to build a nationwide public safety broadband network. The EMS Act of 1973 first identified communications as one of 15 critical EMS components.

QUESTION 2

The primary benefit of centralized dispatch over individual community dispatch centers is:

A. Better 12-lead ECG transmission quality
B. Saves money, manpower, and equipment
C. Faster response times in all geographic areas
D. Superior coordination with air medical services

Answer: B

Centralized dispatch saves money, manpower, and equipment vs. individual community dispatch. Ideally one PSAP per EMS system with trained telecommunicators. The communications system with medical oversight can also route patients to alternative services beyond ED transport.

QUESTION 3

Advanced Automatic Crash Notification (AACN) systems transmit which data to the PSAP?

A. Patient vital signs and ECG data
B. Vehicle crash data and predicted injury probability
C. Driver identity and insurance information
D. Traffic camera footage of the crash

Answer: B

AACN (onboard vehicle system) detects crashes and sends detailed crash data to the PSAP, predicting injury probability. This enables pre-notification of receiving facilities and appropriate resource dispatch before any voice communication occurs.

91 Principles of Finance

Why This Matters

EMS physicians increasingly serve as clinical AND administrative leaders. Financial literacy is a core competency: you can't advocate effectively if you can't speak the language of the CFO.
Key concept: Cost ≠ Charge ≠ Reimbursement. These three terms are not interchangeable.

Cost Terminology

Term	Definition	EMS Example
Direct cost	Traceable to actual service delivery	Labor, fuel, medical supplies, ambulances
Indirect cost	Not directly traceable ("overhead")	Admin, HR, billing, medical director salary
Shared cost	Shared across departments/agencies	Shared comm center, shared facilities
Total (Full) cost	Direct + Indirect + Shared	What it actually costs to run the system

Full Cost = Direct + Indirect + Shared

Managerial Accounting Concepts

Term	Key Point
Average cost	Total cost ÷ units of service (responses or transports)
Fixed cost	Doesn't change with volume (ambulance, station, crew salary)
Step fixed cost	Stays fixed until capacity exceeded: then jumps (need another unit)
Variable cost	Changes with volume (fuel, disposable supplies)
Marginal cost	Cost of ONE additional unit of service (often very low if capacity exists)
Depreciation cost	Loss of asset value over useful life (ambulance $100K ÷ 5 years = $20K/yr)
Opportunity cost	Foregone benefit of the next-best alternative choice
Sunk cost	Already spent, cannot be recovered: do NOT factor into future decisions

Productivity Analysis

Productivity = Outputs ÷ Inputs

Unit Hour Utilization (UHU)
UH (Unit Hour): A fully staffed, equipped ambulance available for 1 hour
U (Utilization): Number of transports completed
UHU = # Transports ÷ # Unit Hours
Unit Hour Utilization (UHU) — Calculation Examples

Example	Calculation
6 transports in a 12-hr shift	UHU = 6 ÷ 12 = 0.5
300 transports, 30 units × 24 hrs	UHU = 300 ÷ 720 = 0.42

UHU goes **up** as productivity increases
Fixed costs contribute **less per transport** as UHU increases
Urban systems have higher UHU than rural (call density, geography)
Comparing UHU across systems is only valid if definitions and demographics are similar — rural vs. urban UHU comparison is a classic analytical error; low rural UHU reflects geography, not inefficiency

Cost Per Transport
Cost per transport = Total system cost ÷ Total transports
OR
Cost per transport = Cost per unit hour ÷ UHU
Example: Unit hour cost = $100, UHU = 0.33 → Cost per transport = $100 ÷ 0.33 = **$303**. As UHU increases, cost per transport decreases (up to the next step-up in capacity).

Applying Finance: Real-World Scenarios

"Wall Time" / Hospital Offload Delays

Increased hospital dwell time → lower UHU → higher cost per transport

Check test: "Would I write or receive a check for this?" If no → it's not a real cost, it's lost productivity (opportunity cost)

Convert UHU losses to "ambulance equivalents" when speaking to city council: tangible and politically resonant

Break-Even Analysis

Break-even cost per visit = Revenue ÷ Required visits

Model optimistic / likely / pessimistic productivity scenarios

Marginal cost thinking: If capacity exists (unused UH), adding MIH visits may cost very little

Value in EMS

Value = Clinical Outcome ÷ Cost

EMS leaders tend to focus on the numerator (outcomes); must also control the denominator (cost)

MIH must capture shared savings — not merely generate them for other sectors: reduced ED visits that save insurer money but don't flow back to the EMS agency = generated (not captured) savings; this financial design flaw is the mechanism behind most MIH program failures after grant funding ends

Key Numbers

Metric	Value
Medicare EMS reimbursement vs. actual cost (2013 urban)	~6% below cost
Break-even concept	Revenue ÷ Required output = max cost per contact

PRIORITY PATCH

Cost types mnemonic "Fix Var Step Mar Dep Opp Sunk": Fixed → Variable → Step → Marginal → Depreciation → Opportunity → Sunk

Sunk cost fallacy: letting past expenditures drive future decisions; a rational decision maker ignores sunk costs

Full cost = direct + indirect + shared; **average cost** = total ÷ services; **marginal cost** = cost of ONE additional unit of service

Break-even = revenue ÷ required output = max cost per contact; below break-even = financially unsustainable

UHU comparisons only valid if definitions and demographics are similar — rural vs. urban UHU comparison is a classic analytical error; low rural UHU reflects geography, not inefficiency

EMS reimbursement typically **below actual cost** (2013 urban: ~6% below); subsidies, billing optimization, and alternative payment models are required

⚡PULSE CHECK

QUESTION 1

An EMS agency is considering running 3 additional calls per day using an already-staffed ambulance. The relevant cost concept for this decision is:

A. Sunk cost analysis
B. Marginal cost analysis
C. Opportunity cost analysis
D. Depreciation cost analysis

Answer: B

Marginal cost = the cost of ONE additional unit of service. When fixed costs (crew salary, ambulance) are already present, the marginal cost of an additional call may be very low (fuel and supplies only). Sunk costs are already spent and should NOT factor into future decisions.

QUESTION 2

Full (total) cost in EMS finance equals:

A. Labor + fuel only
B. Direct + Indirect + Shared costs
C. Charge minus profit margin
D. Reimbursement plus accounts receivable

Answer: B

Full Cost = Direct costs (labor, fuel, medical supplies) + Indirect costs (admin, HR, billing, medical director salary) + Shared costs (shared comm center, facilities). Cost ≠ Charge ≠ Reimbursement --- these terms are not interchangeable.

QUESTION 3

Unit Hour Utilization (UHU) of 0.25 means:

A. Each unit responds to 25 calls per hour
B. Each unit is busy (responding or transporting) for 25% of staffed time
C. The system has 25% spare ambulance capacity
D. Each call takes 25 minutes from dispatch to clearance

Answer: B

UHU = time deployed ÷ total staffed hours. UHU of 0.25 = units occupied 25% of staffed time (15 minutes out of every hour). Productivity = Outputs ÷ Inputs. Optimal UHU balances efficiency with response time performance.

92 State EMS Offices

NASEMSO and the 10-Subsystem Model

The **National Association of State EMS Officials (NASEMSO)** includes all states/territories. In response to the 2006 IOM report on EMS fragmentation, NASEMSO developed a **10-subsystem model** for state EMS:
System Leadership, Organization, Regulation & Policy
Resource Management: Financial
Resource Management: Human Resources
Resource Management: Transportation
Resource Management: Facility & Specialty Care Regionalization
Public Access & Communications
Public Information, Education & Prevention
Clinical Care, Integration of Care & Medical Direction
Information, Evaluation & Research
Large-Scale Event Preparedness & Response

Structure of State EMS Office

Ideally housed in a **cabinet-level lead agency** (most commonly: Dept. of Health; second most: Dept. of Public Safety)
Four required positions:
State EMS System Director: executes statutory responsibilities
State EMS Medical Director: licensed physician responsible for medical oversight
State EMS Advisory/Authority Body: multidisciplinary advisory board
State EMS Medical Committee: provides medical expertise

Regulation vs. Technical Assistance

Statute/Law: cannot be waived (only rarely, when in public interest)
Rules and Regulations: can be waived/exempted by the state
Policy: principle or rule to guide decisions
Procedure: actions executed the same way every time
Standard: requirements to meet a designated purpose (mandatory or voluntary)
Guideline: advisory best-practice suggestions; cannot be mandated

Scope of Practice: The 4-Part Venn

An EMS practitioner may only perform skills for which they are ALL FOUR of:
An EMS practitioner may perform a skill only when ALL four conditions are met: **educated to perform**, **certified as competent**, **state licensed to practice**, and **credentialed by the medical director**.
NHTSA published the National EMS Scope of Practice Model in 2007; updated **2019**
Certification ≠ licensure (NREMT certifies; states license)
Credentialing = the medical director's clinical determination that a practitioner is competent for a specific role within the agency

EMS Compact

Initiated **2014**: states must pass enabling legislation to join
Overseen by the **Interstate Commission for EMS Personnel Practice**
Allows state EMS offices to legally recognize EMS personnel licensed in ANY member state
2020: Commission approved interstate practice without obtaining a license in the remote state
Especially valuable during disasters and mutual aid

State EMS Office Functions

Domain	Key Points
Financial	General fund, block grants, cash funds (MVR fees), licensure fees, federal grants (EMSC, HSGP)
Human Resources	Track BLS/ALS personnel, manage reciprocity, set continuing ed requirements
Transportation	Inspect/license ground, air, water vehicles; set equipment standards; MCI/disaster transport planning
Regionalization	Recognize specialty centers (trauma, stroke, STEMI, burns, etc.); update destination policies
Communications	Statewide communications plan; FirstNet; NIMS compliance; interoperability (DHS SafeCom)
PIER	Public education, injury prevention, media relations: build before crisis
Clinical/Medical Direction	Medical oversight at all system levels; statewide protocols (mandatory or model); QI
Data/Research	NEMSIS-compliant data; CARES; NEMSIS; state QI plan; confidentiality protections
Large-Scale Events	All-hazards approach; EMAC; NIMS; mass gathering + disaster planning

Mandatory vs. Model Statewide Protocols

Mandatory Statewide Protocols	
Pros	Uniform standard; ease of education/CEUs; kept up-to-date; consistent disaster response; frees local MDs for QI/education; evidence-based
Cons	May not recognize local nuances; restricts progressive care; can become stale if not updated; MDs may feel loss of ownership

In 2015, 21 states had mandatory statewide protocols (BLS or ALS), 16 of which applied to both levels. **Key advantage:** frees local medical directors from protocol writing → more time for QI and education. **Key risk:** protocols become outdated if the state update process is slow — regulatory lag can leave clinicians following stale evidence.

PRIORITY PATCH

State EMS medical directors should be **full-time** per joint position statement (NASEMSO/ACEP/NAEMSP, 2010)
EMS practitioners hold their own licenses — they do NOT practice under the physician's license (a common myth)
Four required state EMS positions: System Director, Medical Director, Advisory/Authority Body, Medical Committee; housed ideally in cabinet-level lead agency
EMS Compact: initiated 2014; allows practice across state lines in member states; especially valuable for disasters and mutual aid; 2020 update allows interstate practice without obtaining remote state license — *EMS Compact = operational mechanism; REPLICA = the legal interstate compact framework*; often used interchangeably but technically distinct
NASEMSO 10-subsystem model (post-2006 IOM): System Leadership → Financial → Human Resources → Transportation → Regionalization → Communications → PIER → Clinical/Medical Direction → Data/Research → Large-Scale Events

⚡PULSE CHECK

QUESTION 1

The NASEMSO 10-subsystem model was developed in response to which report?

A. 1966 NAS-NRC White Paper
B. 1973 EMS Systems Act
C. 2006 IOM report on EMS fragmentation
D. 2010 ABEM subspecialty recognition

Answer: C

NASEMSO's 10-subsystem model was developed in response to the 2006 IOM report highlighting EMS fragmentation. The 10 subsystems include: System Leadership/Regulation, Financial/Human/Transportation/Facility Resource Management, Public Access/Communications, Public Information/Prevention, Clinical Care/Medical Direction, Information/Research, and Large-Scale Event Preparedness.

QUESTION 2

State EMS offices are most commonly housed within which state agency?

A. Department of Transportation
B. Department of Health
C. Department of Public Safety
D. Department of Emergency Management

Answer: B

Most commonly: Department of Health. Second most common: Department of Public Safety. Ideally housed in a cabinet-level lead agency.

QUESTION 3

Which position is a required component of every state EMS office?

A. State EMS Training Officer
B. State EMS Medical Director (licensed physician)
C. State EMS Legal Counsel
D. State EMS QA Coordinator

Answer: B

Four required positions: State EMS System Director (executes statutory responsibilities), State EMS Medical Director (licensed physician responsible for medical oversight), State EMS Advisory/Authority Body (multidisciplinary), and State EMS Medical Committee (medical expertise).

93 EMS–Public Health Interface

Public Health vs. Clinical Medicine

	Clinical Medicine	Public Health
Focus	Individual patients	Communities and populations
Goal	Treat disease/injury	Prevent disease/injury; improve health
Tools	Clinical care	Epidemiology, policy, education, surveillance

EMS sits at the intersection of emergency medicine, public health, and public safety.

Epidemiology

Definition: The study of the distribution (frequency, pattern) and determinants (causes, risk factors) of health-related states in specified populations
Father of epidemiology: Dr. John Snow: 1854 Broad Street cholera outbreak, dot map methodology
Each EMT/paramedic knows the "trouble spots" in their jurisdiction: this is **ground-level epidemiologic intelligence** that is chronically underutilized — EMS data should actively feed public health surveillance and resource allocation, not just flow one direction to the ED

Healthy People Initiative

Started 1979 (Surgeon General Julius Richmond)
Decade-long goal-setting for U.S. population health
Healthy People 2030: current iteration
EMS agencies can align local public health efforts with these national goals

EMS–Public Health Intersection Programs

Child car seat installation/training
Bystander CPR promotion
DNR/MOLST/MOST programs
Bicycle helmet campaigns
Fall prevention for elderly
Mass vaccination programs
Blood pressure/glucose screenings
High-volume user case management
Naloxone bystander distribution
Tracking naloxone use to identify focal opioid clusters
Syndromic surveillance for outbreak detection

Public Health Surveillance

Surveillance = ongoing, systematic collection, analysis, and interpretation of health data → used for health action
Uses include:
Estimating magnitude of health problems (e.g., OHCA)
Detecting epidemics / behavioral changes (e.g., opioid use)
Identifying patients/contacts for contagious disease (e.g., COVID-19)
Monitoring infectious/environmental agents (e.g., seasonal influenza)
Assessing program effectiveness (e.g., bystander CPR on survival)
Generating research hypotheses
Syndromic surveillance = early identification of illness clusters based on symptoms BEFORE diagnoses confirmed
NYC began ambulance dispatch syndromic surveillance in 1998
Real-time software can integrate 9-1-1/ePCR/hospital/poison control data

Key Databases

Database	Key Facts
CARES (Cardiac Arrest Registry to Enhance Survival)	Developed 2004, CDC + Emory; tracks OHCA using Utstein template; >28 states + DC; >1,800 EMS agencies; >2,200 hospitals; catchment >140 million people
NEMSIS (National EMS Information System)	Established 2001; NASEMSD + NHTSA + HRSA; first data dictionary 2003; version 3.4.0 has >500 data elements; 34+ million EMS activations in 2019 dataset

Public Access Defibrillation (PAD)

1994: First AHA conference on PAD
AEDs at airports, schools, fitness centers, churches, workplaces → improved ROSC, survival, neurologic outcomes
Cost per QALY: $30,000–$100,000 (within accepted range)
2006 AHA: Recommended states adopt PAD legislation
By 2010: **All 50 states + DC** had at least one PAD law
EMS physician role: Advocate for evidence-based PAD legislation

Crowdsourced CPR

PulsePoint (San Ramon, CA; founded 2011): Mobile app dispatches volunteer CPR-trained bystanders when OHCA occurs in a **public space**; shows AED locations — **limitation:** 70–80% of OHCA occurs at home (unreachable by app); limits population-level impact despite proven effectiveness in public venues
Stockholm study (2015): Mobile phone CPR dispatch → significantly increased bystander CPR rates
70–80% of CPR cases occur in or around the home; most victims are known to the rescuer

Mass Vaccination and Paramedics

Paramedics are within national scope for IM injections
Used in COVID-19 pandemic for mass vaccination campaigns
2009 H1N1: Wisconsin encouraged EMS involvement in vaccination clinics
2010: Virginia legislature authorized paramedic vaccine administration
Paramedics: trusted, insured, mobile, organized, government-employed: ideal vaccinators

PRIORITY PATCH

CARES: Cardiac Arrest Registry to Enhance Survival; CDC + Emory, 2004; tracks OHCA via Utstein template; >28 states + DC; catchment >140 million people
NEMSIS: National EMS Information System; established 2001; v3.4.0 has >500 data elements; 34+ million EMS activations in 2019 dataset
PAD: by 2010, **all 50 states + DC** had at least one PAD law; cost per QALY: $30,000–$100,000 (within accepted range)
PulsePoint (2011): dispatches volunteer CPR bystanders in **public spaces only**; Stockholm study (2015): mobile phone dispatch → increased bystander CPR — but 70–80% of OHCA occurs at home (unreachable by app), limiting population-level impact
EMS–public health tools: naloxone distribution + use tracking to identify opioid clusters; syndromic surveillance; bystander CPR promotion; mass vaccination; fall prevention

⚡PULSE CHECK

QUESTION 1

John Snow's father-of-epidemiology designation was earned through which methodology during the 1854 Broad Street cholera outbreak?

A. Randomized controlled trial methodology applied to cholera treatment
B. Dot mapping to identify spatial distribution and source of disease
C. Mandatory quarantine and isolation protocols
D. Development of the first cholera vaccine

Answer: B

Dr. John Snow used dot mapping to trace the 1854 cholera outbreak to the contaminated Broad Street water pump --- the first epidemiologic investigation linking disease distribution to a causal source. He is the father of epidemiology.

QUESTION 2

The current iteration of the Healthy People initiative is:

A. Healthy People 2010
B. Healthy People 2020
C. Healthy People 2030
D. Healthy People 2040

Answer: C

Healthy People 2030 is the current iteration. The initiative started in 1979 (Surgeon General Julius Richmond). EMS agencies can align local public health efforts with Healthy People national goals.

QUESTION 3

EMS contributes to public health beyond emergency response through:

A. EMS role is strictly limited to emergency clinical care
B. Naloxone distribution, child car seat education, fall prevention, and mass vaccination programs
C. EMS is limited to data reporting; public health interventions are hospital-only
D. EMS contributes only through mandatory disease reporting

Answer: B

EMS--public health intersection programs: naloxone bystander distribution, child car seat installation/training, bystander CPR promotion, fall prevention for elderly, blood pressure/glucose screenings, bicycle helmet campaigns, DNR/MOLST programs, and mass vaccination programs.

94 EMS Physicians as Public Spokespersons

Basic Assumptions Before Speaking

You are the appropriate spokesperson and have authorization
For specific patients: notify patient/family, obtain permission
Proactive communication minimizes harm from eventual disclosure
Be a sincere patient advocate above all else: not self-promoter

The Effective Sound Bite: "Three-Part Format"

Definitive opener: "Absolutely!" / "The data are clear!"
Core explanation: Your key message (one sentence)
Parting resolve: "...which is why we all need to know CPR!"
Target: **~10 seconds total**
Avoid repeating the negative framing of a reporter's question
Focus on your communicative objective, not the interviewer's direction
"Glass is half full" on issues; less optimistic on individual patients
Example: Q: "Is there a risk of getting AIDS from CPR?" → A: "Remember: 70–80% of cardiac arrests happen at home, and it's going to be someone you know. Knowing CPR may be their only hope."

Media Types and Their Differences

Medium	Characteristics	Strategy
Electronic/TV	Exact words broadcast; short clips used	Short, energetic, focused soundbite
Print	Risk of paraphrasing; longer shelf life	Talk slowly; offer to review quotes; budget review time
Social media	Instantaneous, permanent, broad reach	Assume everything is on record; consistent messaging
Press conferences	Coordinated, multi-speaker, formal	10–15 min max; 2 min/speaker; use visuals; designate roles

For print: Ask the reporter to call back after writing to verify accuracy. Frame it as your limitation, not theirs.

Press Conference Composition (Sample: AED Program)

Master of ceremonies (EMS physician, mayor, or AHA rep)
Expert speaker (facts, rationale: cardiologist or EMS physician)
Counter-argument expert (pre-empts opposition: e.g., attorney addressing liability concerns)
"I'm a good example" person (AED survivor)
"How to get involved" person (clearinghouse, next steps)
Demonstration (visual: mannequin CPR, child using AED)

10 Golden Rules for Public Communication

#	Rule
1	Always tell the truth: but do it in a 10-second soundbite
2	Respond quickly; be a readily available and helpful resource
3	Be a human being: act like one and talk like one
4	Glass is half full on issues; less optimistic on individual patients
5	Make others look good and you will look good
6	Provide a good "hook": suggest a simple, valuable lesson
7	Provide simple statistics and graphics
8	Stay on the mark: remember the 3 Rs: Repetition, Redundancy, Reiteration
9	Don't trust everyone: there is NO "off the record"
10	Anticipate the worst and expect the mediocre

PRIORITY PATCH

Sound bite format: definitive opener → one-sentence message → parting resolve; target ~10 seconds total; never repeat the negative framing of the reporter's question
No "off the record" — assume everything is on record across all media; social media posts are permanent
Press conference: MC → expert → **counter-argument expert** (*most frequently omitted* — pre-empts opposition's strongest argument before publication) → survivor/"good example" → "how to get involved" → demonstration: all 6 roles serve a purpose
Print media: talk slowly; ask to review quotes before publication (**frame as your limitation**: "I want to make sure I explained it clearly" — more effective than implying distrust of the reporter); budget time for that review
Golden Rule #9: **Don't trust everyone**; Rule #10: **Anticipate the worst, expect the mediocre**
Glass half full requires deliberate code-switching: optimistic for systemic issues (builds public support and confidence); cautious on individual patients (false hope damages credibility and harms families) — these are different messaging modes, not contradictions

⚡PULSE CHECK

QUESTION 1

The effective EMS physician sound bite follows which three-part format?

A. Core message, statistical support, parting resolve
B. Definitive opener, core explanation, parting resolve
C. Problem statement, solution, call to action
D. News hook, personal story, data point

Answer: B

Three-part format: (1) Definitive opener ('Absolutely!'), (2) Core explanation (one key message sentence), (3) Parting resolve ('\...which is why we all need to know CPR!'). Target: ~10 seconds total. Avoid repeating the negative framing of reporter questions.

QUESTION 2

When speaking to print media, which strategy is recommended?

A. Speak rapidly to fit more information into the interaction
B. Speak slowly and offer to review quotes before publication
C. Avoid all print media because paraphrasing is uncontrollable
D. Provide only written statements; decline all interviews

Answer: B

Print media: speak slowly (risk of paraphrasing), offer to review quotes (longer shelf life). Electronic/TV: short, energetic soundbites. Social media: instantaneous and permanent --- assume everything is on record.

QUESTION 3

Which of the following is NOT a component of an effective media sound bite?

A. Definitive opener
B. Core explanation
C. Parting resolve
D. Follow the interviewer's direction

Answer: D

A, B, and C are all components of an effective media sound bite. Target 10 seconds total and avoid being directed away from your intended message by interviewers.

95 Incident Command System and National Incident Management System

Why ICS Exists

Bureaucracy (rigid hierarchy, complex procedures, specialization) = wrong structure for disasters
Best for: high-volume, routine, stable situations
Disasters require: flexible, temporary, high-reliability organizations
ICS was developed mid-1970s by **FIRESCOPE** (Firefighting Resources of California Organized for Potential Emergencies) after management failures during California wildland fires. Phoenix FD later adapted it into the **Fireground Command System (FCS)**.

NIMS vs. ICS

	NIMS	ICS
What it is	National framework for emergency management	The on-scene management system
Scope	Multi-agency, multi-jurisdictional coordination	Command and coordination at the incident level
Components	Resource mgmt, command & coordination, communications	Scalable organizational structure at the scene
Legal basis	Required by HSPD-5 for all state/federal agencies	Component of NIMS

NIMS = standards, processes, and terminology; **ICS** = the actual management structure applied at the incident.

Core ICS Principles

Principle	Definition
Unity of command	Each member reports to exactly ONE supervisor
Span of control	No supervisor directly oversees more than 3–7 (optimally 5) people/functions
Modular expansion	ICS expands or contracts based on incident size/complexity
Transfer of command	Orderly change of IC when phases complete or extended operations require rest
Job Action Sheets	Reference guides for each command role; decision and documentation tool

IC Priorities (in order):
Life safety
Incident stabilization
Property and environment conservation

ICS Organizational Structure

Command Staff (Not in IC's span of control)

Position	Role
Safety Officer	Scene safety for ALL people; ONLY person who can override IC (emergency "stop" orders)
Public Information Officer (PIO)	Media and public interface; deflects from IC
Liaison Officer	Conduit between IC and external agencies (tow companies, buses, politicians)

Joint Information Center (JIC): Multi-agency PIO coordination, usually off-site; uses the Joint Information System (JIS) plan.

General Staff (Section Chiefs report to IC)

Section	Chief Title	Key Functions
Operations	Operations Section Chief	Tactical decisions; executes IAP; supervises staging manager
Planning	Planning Section Chief	Situational assessment; drafts IAP; manages tech specialists; demobilization plan
Logistics	Logistics Section Chief	Communications, food/water for responders, fuel, facilities, command post
Finance/Administration	Finance/Admin Section Chief	Procurement, personnel records, cost tracking: needed when significant spending required

Organizational Levels (Hierarchy)

Level	Led By	Geographic?	Predefined?	Examples
Sections	Chief	No	Yes	Operations, Planning, Logistics, Finance
Branches	Director	No	No	EMS Branch, Law Enforcement Branch
Divisions	Supervisor	Yes (geographic)	No	North Division, Floor 3 Division
Groups	Supervisor	No (functional)	No	Triage Group, Treatment Group, Transport Group
Units	Leader	No	No	Supply Unit, Situation Unit

Resources

Type	Description
Single resource	One individual or piece of equipment with personnel (e.g., ALS ambulance)
Task force	Mixed resources with common comms and a leader (e.g., 4 engines + 4 police + epidemiologist)
Strike team	Set number of SIMILAR resources with common comms and leader (e.g., 5 ALS units)

Unified Command

Used when **multiple agencies/jurisdictions** have legitimate authority
Senior representatives of each agency co-located in command post
Each serves as IC for their jurisdiction; speak with **one voice**
Requires single Operations Section Chief to execute the Incident Action Plan (IAP)
Agencies maintain separate command responsibilities while sharing the command function — Unified Command is NOT a merger of authority
Unity of command preserved: responders still report to ONE supervisor

Incident Action Plan (IAP)

Drafted by Planning Section, approved by IC
Outlines tactical/strategic objectives and resource requirements for each operational period
Used for initial briefing of incoming command shift

ICS Training Courses (NIMS: required for EMS physicians)

Course	Content
ICS-100	Introduction to ICS (history, features, principles, structure)
ICS-200	ICS for single resources and initial action incidents (unified command, delegation, IAP)
IS-700	NIMS overview (components, EOC functions, interconnectivity with ICS)
IS-800	National Response Framework intro (core capabilities, coordinating structures)

All ICS/NIMS courses are available free online through FEMA's Emergency Management Institute.

Resource Typing and Pre-Credentialing

Resource typing: Standardized catalog of resources (4 types by capability/staffing)
Pre-credentialing: Qualifications verified BEFORE activation → faster deployment
Allows rapid interoperability across jurisdictions

PRIORITY PATCH

ICS sections: "FLOP" — Finance, Logistics, Operations, Planning; each led by a Section Chief reporting to the IC; **typical activation order: Operations → Logistics → Planning → Finance** (Finance only when significant spending required)
Safety Officer is the ONLY person who can override the IC — for **imminent life safety threats only**, not tactical disagreements; PIO handles all media; Liaison Officer connects to external agencies
Span of control: 3–7 (optimal 5); **Unity of command**: one supervisor per person; these apply even in Unified Command
Divisions = geographic; **Groups** = functional; **Strike teams** = similar resources; **Task forces** = mixed resources
ICS-100, ICS-200, IS-700, IS-800: required for EMS physicians; all free online via FEMA EMI; **NIMS compliance required by HSPD-5** for all state/federal agencies; **ICS-300/400 (intermediate/advanced) are recommended but NOT required by HSPD-5**

⚡PULSE CHECK

QUESTION 1

ICS was originally developed in the mid-1970s by which organization?

A. FEMA
B. FIRESCOPE (Firefighting Resources of California Organized for Potential Emergencies)
C. NIMS
D. DHS

Answer: B

ICS was developed mid-1970s by FIRESCOPE after management failures during California wildland fires. Phoenix FD adapted it into the Fireground Command System (FCS). NIMS is the broader national framework within which ICS operates as the on-scene management system.

QUESTION 2

ICS 'span of control' specifies that no supervisor should oversee more than how many people?

A. 3--5
B. 3--7 (optimally 5)
C. 5--10
D. 7--15

Answer: B

Span of control: no supervisor directly oversees more than 3--7 people/functions (optimally 5). Unity of command: each member reports to exactly ONE supervisor. These principles ensure manageable operations at any incident scale.

QUESTION 3

NIMS was mandated for all state and federal agencies by which directive?

A. Presidential Policy Directive 8 (PPD-8)
B. Homeland Security Presidential Directive 5 (HSPD-5)
C. National Response Framework (NRF)
D. Stafford Act

Answer: B

HSPD-5 mandated NIMS for all state/federal agencies. PPD-8 established the National Preparedness Goal. The NRF defines doctrine for national response. The Stafford Act governs presidential disaster declarations.

96 Medical Management of Mass Gatherings

Definitions

Mass gathering: An event that strains the planning and response resources of the community (WHO definition: NOT purely number-based)
FEMA "Special Event": A non-routine activity bringing large numbers of people, emphasized by community impact rather than attendee count
Most published data involve events with **>25,000 persons**, but some jurisdictions define mass gathering as >1,000
Key concept: Mass gatherings are not isolated events — they create system-wide strain and risk for escalating incidents.

Goals of Mass Gathering Medical Care (NAEMSP)

Evaluate and stabilize injury/illness per community standard of care
Preserve the capacity of local public health and acute care systems
Optimally respond to extraordinary or catastrophic events using ICS/NIMS

Five Risk Management Areas (Soomaroo & Murray)

Overcrowding and crowd control
Event access points
Fire safety measures
Medical preparedness
Emergency response

Event Descriptors and Resource Needs

Descriptor	Lower Resources	Higher Resources
Location footprint	Single, fixed site (art festival)	Multiple or mobile (road race)
Venue	Enclosed, good access (stadium)	Non-event focused, access issues (marathon)
Purpose	Celebratory	Highly emotional (political protest)
Size	Small	Large
Participants	Screened, typical health profile	Unscreened, special needs (elderly rock fans)
Duration	Short with breaks	Long, no breaks
Timing	Slow onset, time to plan	Rapid onset, no time to cancel
Activities	Low stress	High stress (heat, physical exertion, confrontation)
Capacity	At or below capacity	At or exceeding capacity

Key Metrics

Metric	Definition	Benchmark
PPR (Patient Presentation Rate)	Patients per 10,000 attendees	**0.5–2 per 1,000** is typical (5–20 per 10,000)
MUR (Medical Usage Rate)	Same as PPR	Varies by event type
TTHR (Transport to Hospital Rate)	Patients transported per 10,000 attendees	Use for planning recurring events

Resource Staffing Guidelines (Not Evidence-Based)

Clinician	Guideline Range
Physician	1 per 5,000–50,000 spectators
Nurse	1 per 2,600–15,000 spectators
EMT	1 per 2,600–65,000 spectators
Mobile team	≥ 1 per 20,000 spectators

Alternative (response interval model: Saunders):
BLS/first aid within **4 minutes**
ALS within **8 minutes**

Transport to facility within **30 minutes**
Physician on scene: reduces transport rates, expands on-site scope, enables chemical sedation and AMA releases without base hospital contact.

Mass Gathering Medical Planning Elements

Medical oversight: Event medical director (EMS background ideal)
Timeline: Preplanning → Planning → Operations → Post-event review (up to 2 years in advance for large events; 30 days minimum for plan approval)
Medical plan: Should be self-contained (not reliant on local EMS system); approved ≥30 days prior
Public health surveillance: Infection control, syndromic surveillance, monitor substance use trends
Documentation: Every patient encounter on standardized PCR (medical/legal record)
Communications: Two separate modalities (radio + cell); pre-established channels for MCI operations; social media monitoring
Disaster preparedness: Pre-designated ICS roles; job action sheets; mutual aid agreements
Post-event review: PPR, TTHR, patient types; after-action report; lessons learned

Care Team Types

Team	Role
First aid teams	Fixed stations (ED-level to basic first aid depending on staffing); tents, mobile ICU vans
Sobering team	Manage intoxicated participants with protocol-driven observational care; ALS backup available
Mobile teams	Foot, bicycle, golf cart; minimum 2 personnel (≥1 EMT); AED access within 3 min for OHCA
Transportation teams	ALS/BLS units for complex patients; air medical integration if distances are great

Converting to MCI Operations

When an event escalates:
Activate the event emergency plan
On-site communications notify command center
First responders report: nature, hazards, estimated patients, resources needed, best ingress/egress
Command center contacts local PSAP → activates local/regional MCI plan
Clinicians transition to pre-designated MCI roles, don ICS vests
Mobile teams perform initial triage
Fixed facilities transition to treatment areas by category (red/yellow/green/black)
Pre-designated staging/transport area activated
Hospitals previously notified of mass gathering → activate surge capacity

PRIORITY PATCH

Mass gathering definition: strains community planning/response resources (WHO — NOT purely number-based); most data involve >25,000 persons
PPR (Patient Presentation Rate): patients per 10,000 attendees; typical 5–20/10,000; use **TTHR** for recurring event planning
Response interval model (Saunders): BLS within **4 min**, ALS within **8 min**, transport within **30 min** — **staffing ratios (e.g., 1 physician per 5,000–50,000) are NOT evidence-based**; Saunders response interval model is the evidence-informed preferred approach
Medical plan: self-contained (not reliant on local EMS); approved **≥30 days prior**; two separate communication modalities required
Pre-designate ICS roles before the event — personnel should know job action sheets before chaos starts; pre-designation creates a starting point, not a rigid assignment
On-scene physician primarily **reduces unnecessary transports via real-time risk stratification** — this is the primary cost-benefit argument for physician presence at large events

⚡PULSE CHECK

QUESTION 1

The WHO definition of a mass gathering is based primarily on which criterion?

A. Any event with more than 1,000 persons
B. Any event that strains the planning and response resources of the community
C. Any event with more than 25,000 attendees
D. Any event requiring a dedicated medical team

Answer: B

WHO definition: a mass gathering strains the planning and response resources of the community --- NOT purely number-based. FEMA 'Special Events' are also defined by community impact rather than attendee count. Most published data involves events >25,000 persons.

QUESTION 2

Which mass gathering characteristic is associated with HIGHER medical resource needs?

A. Single, fixed site
B. Enclosed venue with good access (stadium)
C. Celebratory purpose
D. Mobile or multiple-site event (road race)

Answer: D

Higher resources needed: mobile/multi-site events, non-event venues with access issues, emotional/political purposes, large unscreened populations, and long duration without breaks. Lower resources: single fixed sites, enclosed venues with good access, celebratory purpose.

QUESTION 3

NAEMSP goals for mass gathering medical care include:

A. Providing advanced subspecialty care for all attendees
B. Evaluate/stabilize per community standard of care AND preserve local system capacity
C. Replacing local EMS during the event
D. Providing BLS care only to minimize cost

Answer: B

NAEMSP goals: evaluate and stabilize per community standard of care, preserve the capacity of local public health and acute care systems, and optimally respond to extraordinary events using ICS/NIMS. Mass gatherings create system-wide strain beyond the event itself.

97 Disaster Preparedness and Management

Disaster Categories (Strategic National Risk Assessment)

Category	Examples
Natural hazards	Floods, earthquakes, hurricanes, wildfires, pandemics, volcanoes, space weather
Technological/accidental	Chemical spills, dam failures, biologic food contamination, radiological releases
Adversarial/human-caused	Bioterrorism, explosives, armed assault, nuclear terrorism, cyber attacks, aircraft as weapons

Federal Framework (PPD-8)

Presidential Policy Directive 8 (PPD-8): National preparedness is a SHARED responsibility of all government levels + private sector + individuals

Established the **National Preparedness Goal** and national planning frameworks

Five Mission Areas:

PPD-8 National Preparedness Mission Areas

Mission	Description
Prevention	Avoid, prevent, or stop imminent threats
Protection	Secure the community against threats
Mitigation	Reduce loss of life/property by limiting disaster impact
Response	Save lives, protect property and environment, meet basic needs
Recovery	Restore community to normalcy

National Response Framework (NRF)

Defines the doctrine for national response to any incident

Based on **PPD-8**; aligned with NIMS

Describes core capabilities, emergency support functions (ESFs), coordinating structures

Emergency Support Functions (ESFs) — 15 total, including:

ESF #	Function	Example Supporting Action
#1	Transportation	Open roads for health facility access
#2	Communications	Contingency comms for medical facilities
#3	Public Works/Engineering	Install generators at health facilities
#8	**Public Health & Medical Services**	**Main ESF for EMS/medical response**
#9	Search & Rescue	Initial health needs assessments
#13	Public Safety/Security	Security at health facilities
#15	External Affairs	Public messaging on available health services

ESF #8 is the primary federal function for EMS and medical response — the EMS physician's home base in a federal disaster.

NIMS: Three Major Components

Resource management: standardized mechanisms to manage and share personnel, equipment, facilities

Command and coordination: ICS, EOCs, multiagency coordination

Communications and information management: common operating picture; interoperability

Non-Governmental Resources

Organization	Key Facts
American Red Cross	Chartered by Congress; ESF #6 (mass care/shelter); special relationship with federal government
VOAD (Voluntary Organizations Active in Disaster)	70+ faith-based/community/non-profit NGOs; national network
Medical Reserve Corps (MRC)	HHS/Surgeon General; local groups of screened, credentialed medical/public health volunteers
CERT (Community Emergency Response Teams)	FEMA-coordinated; basic disaster skills; search/rescue; medical first response

State Response Mechanisms

Mechanism	Key Facts
ESAR-VHP	Emergency System for Advance Registration of Volunteer Health Professionals; Congress 2002; HHS/ASPR; pre-verified credentials
EMAC (Emergency Management Assistance Compact)	Congress ratified 1996; all 50 states + DC + PR + Guam; governor-declared emergency → share personnel/equipment; licenses recognized in receiving state; receiving state bears cost
National Guard	Governor-activated; medical capabilities, comms, logistics, CBRNE response

EMAC 2005 Gulf hurricanes example: 46,503 National Guard, 6,882 law enforcement, 2,825 HAZMAT, and 9,719 other responders deployed across state lines.

National Disaster Medical System (NDMS)

Coordinated by **DHHS** in partnership with DHS (FEMA), DOD, VA
Three missions: Response, patient movement, definitive medical care
~5,000 deployable personnel in **~80** teams
Team members are **volunteers** who become **intermittent federal employees** when activated → pay, workers' comp, Federal Tort Claims Act protection, nationwide licensure recognition
Self-sufficient for 72 hours, typically deploy for **14 days**

NDMS Team Types

Team	Personnel	Mission
DMAT (Disaster Medical Assistance Team)	MD, RN, NP/PA, paramedic, non-clinical support	Medical care/triage; 7-, 14-, or 35-person configurations; deploy within 8 hrs
TCCT (Trauma and Critical Care Team)	Board-certified surgical/trauma specialists	Trauma/critical care; field hospitals or augmentation
DMORT (Disaster Mortuary Operational Response Team)	Pathologists, medical examiners, forensic specialists	Victim identification and processing
Victim Information Center Team	Data specialists	Ante-mortem data, family liaison
NVRT (National Veterinary Response Team)	Veterinarians, techs, epidemiologists	Service/working animals; zoonotic disease assessment

Crisis Standards of Care (Institute of Medicine 2009)

Five key elements:
IOM Crisis Standards of Care — Key Elements

Element	Key Points
Ethical considerations	Fairness, duty to care, duty to steward resources, transparency, consistency, proportionality, accountability
Community engagement	Stakeholder identification; build trust; cultural values; risk communication
Legal authority	Medical/legal standards; scope of practice; mutual aid; EMTALA/HIPAA waivers
Indicators and triggers	Situational awareness; when to initiate crisis standards vs. return to conventional care
Clinical process	Local/state protocols; incident management; coordination; vulnerable populations

Resource Allocation Ethics

Primary principle: Likelihood of medical benefit (beneficence + utilitarianism)
Macro-allocation: Broad policy decisions (trauma center distribution, ICU beds)
Micro-allocation: Individual patient prioritization
When similar medical benefit, secondary principles include:
Equal chance (lottery, first-come/first-served): egalitarian
Social worth/utility assessment: utilitarian (but subject to bias)
SALT triage is endorsed for crisis resource allocation because it uses objective physiologic criteria plus LSIs to minimize subjective decision-making and **implicit bias**. Social utility assessments (the alternative) are vulnerable to racial, socioeconomic, and disability-based discrimination — SALT's objective criteria are specifically preferred to prevent this.

Credentialing in Disasters

Key issues:
Out-of-state providers may lack state licensure
EMAC provides temporary recognition when governor declares emergency
ESAR-VHP pre-verifies credentials before disaster
Scope of practice expansion examples: pharmacists giving vaccines, PAs performing procedures at field stations, paramedics in hospital EDs
Planning section of ICS oversees provider credentialing during active response

PRIORITY PATCH

PPD-8 **five mission areas**: Prevention → Protection → Mitigation → Response → Recovery; **common exam trap:** Mitigation = reduce loss *before* disaster (building codes, flood barriers); Prevention = stop threats from occurring (counterterrorism) — these are frequently confused
ESF #8 (Public Health and Medical Services): coordinator and primary agency = DHHS/ASPR; 16 supporting agencies; main ESF for EMS/medical response
NDMS: ~5,000 deployable personnel in ~80 teams; self-sufficient **72 hours**, typically deploy **14 days**; volunteers become intermittent federal employees when activated
EMAC (ratified 1996): all 50 states + DC + territories; governor-declared emergency → share personnel/equipment; licenses recognized in receiving state; receiving state bears cost
Crisis standards of care can only be altered by an executive governmental official (governor, president, HHS secretary) via formal declaration — NOT blanket permission to disregard all laws

⚡PULSE CHECK

QUESTION 1

Which of PPD-8's five mission areas focuses on reducing loss of life by limiting disaster impact BEFORE it occurs?

A. Prevention
B. Protection
C. Mitigation
D. Response

Answer: C

PPD-8 Mission Areas: Prevention (stop imminent threats), Protection (secure against threats), Mitigation (reduce loss by limiting impact), Response (save lives), Recovery (restore normalcy). Mitigation occurs before disasters strike.

QUESTION 2

An emergency declaration differs from a major disaster declaration because:

A. Emergency declarations require documented impact
B. Emergency declarations can be made BEFORE a disaster strikes to pre-position resources; major disaster declarations require documented impact
C. Major disaster declarations are made by the governor only
D. They are interchangeable

Answer: B

Emergency declaration: can be made BEFORE a disaster to pre-position resources; does NOT require documented impact. Major disaster declaration: requires documented impact; provides comprehensive federal support. Knowing this pre-disaster capability is directly tested.

QUESTION 3

Which ESF (Emergency Support Function) coordinates public health and medical services in the NRF?

A. ESF-1 (Transportation)
B. ESF-4 (Firefighting)
C. ESF-8 (Public Health and Medical Services)
D. ESF-13 (Public Safety and Security)

Answer: C

ESF-8 (DHHS/ASPR) coordinates Public Health and Medical Services. There are 15 ESFs total in the NRF. ESF-1 covers transportation; ESF-4 firefighting; ESF-13 public safety and security.

98 The Federal Medical Response to Disasters

Federal Response Architecture

Local incident → Local EMS/PSAP → Local EOC → Mayor/County official → Governor
If overwhelmed: Governor → State emergency declaration → EMAC (other states)
If still overwhelmed: Governor requests federal assistance → FEMA + DHS Secretary → Presidential declaration
Stafford Act activated → FEMA mission assignments → ESF activation
ESF-8 (DHHS/ASPR) → Medical response teams deployed

History of the National Response Framework

Year	Document	Reason for Change
1992	Federal Response Plan (FRP)	Original federal roles
2002	Revised FRP	Post-9/11 capabilities
2004	National Response Plan (NRP)	**9/11 lesson:** new DHS structure; first integrated federal response plan
2006	NRP Revision	Hurricane Katrina/Rita lessons
2008	**National Response Framework (NRF)**	**Katrina lesson:** addressed bureaucracy/redundancy of NRP
2013	NRF 2nd edition	**Sandy lesson:** added "whole community" concept
2019	**NRF 4th edition**	Current version

NRF Structure

Base document: "How-to" guide using NIMS; 7 sections; "whole community" approach
Annexes:
ESF Annexes (15): Primary operational mechanism; each has coordinator + primary + supporting agencies
Support Annexes (8): Functional/administrative processes (financial management, public affairs, tribal relations, volunteer/donations, etc.)
Incident Annexes (9): Specific incident types (biological, cyber, mass evacuation, nuclear/radiological, terrorism, etc.)

ESF-8: Public Health and Medical Services

Coordinator and Primary Agency: DHHS (via ASPR)
16 supporting agencies
Functional areas include:
Public health/medical needs assessment
Health surveillance
Medical/veterinary equipment and supplies
Patient movement
Patient care
Safety of drugs/biologics/devices
Blood and tissues
Food safety
Medical surge
Behavioral health care
Mass fatality management
Veterinary support

U.S. Public Health Service Response

Tiered, scalable response:
U.S. Public Health Service Response Teams

Team	Capability	Response Time
RIST (Regional Incident Support Team)	Rapid regional response; coordinates initial federal response	<4 hours
NIST (National Incident Support Team)	Same as RIST; nationally deployable	Similar rapid
Rapid Deployment Force	Initial medical care; supports Federal Medical Stations	Short-term deployment

RIST and NIST hand off to the full Incident Management Team (IMT) once it's in place.

Key Legal Authorities for Federal Medical Response

Law/Directive	Key Points
EMAC	All US states/territories; governor declaration; temporary license recognition; receiving state pays
Stafford Act (PL 100-707, 1988)	Primary authority for federal disaster involvement; two declaration types (major disaster = comprehensive; emergency = limited but can be pre-disaster)
PAHPA (PL 109-417)	Created ASPR; established National Health Security Strategy; medical countermeasures authority
PAHPRA (PL 113-5)	Reauthorized PAHPA; expanded Hospital Preparedness Program; Project BioShield
PAHPAIA (PL 116-22)	Further strengthened DHHS public health emergency role
Social Security Act	DHHS secretary can temporarily waive Medicare/Medicaid provisions during declared emergency
Homeland Security Act (PL 107-296, 2002)	Established DHS; merged FEMA into DHS
HSPD-5	DHS secretary = principal federal official for domestic incident management; required NIMS and NRF
PPD-8	Shared responsibility for preparedness; superseded HSPD-8
HSPD-21	Addresses catastrophic health events; four main areas: biosurveillance, countermeasure distribution, mass casualty care, community resilience
NSPM-14	National Biodefense Strategy (2018); superseded PPD-2, HSPD-10, NSPD-33

PRIORITY PATCH

Stafford Act (PL 100-707, 1988): primary authority for federal disaster involvement; two types: major disaster (comprehensive, requires documented impact) and emergency (**can be declared before disaster strikes** to pre-position resources — does not require documented impact)
NRF 4th edition (2019) is current; **lesson-driven evolution: 9/11 → NRP (2004); Katrina → NRF (2008)**, addressed NRP bureaucracy; **Sandy → "whole community" (2013 2nd Ed)**; knowing which disaster drove which revision is tested
PAHPA (PL 109-417): created ASPR; established National Health Security Strategy; PAHPRA (PL 113-5) expanded Hospital Preparedness Program
HSPD-5: DHS secretary = principal federal official for domestic incident management; required all agencies to use NIMS and NRF
Social Security Act: DHHS secretary can temporarily waive Medicare/Medicaid provisions during declared emergency — enables **alternate care site reimbursement, scope of practice expansions, and telemedicine**; this was the specific legal authority behind COVID-19 telehealth expansion and alternate care sites; **HSPD-21**: four areas = biosurveillance, countermeasure distribution, mass casualty care, community resilience

⚡PULSE CHECK

QUESTION 1

In the federal disaster response architecture, which step immediately precedes a presidential disaster declaration?

A. Mayor requests federal assistance directly from the President
B. Governor requests federal assistance after state resources are exhausted
C. FEMA director declares the need for presidential action
D. DHS Secretary automatically activates ESF-8

Answer: B

Sequence: local → local EOC → governor → state emergency declaration → EMAC (other states) → if overwhelmed → Governor requests federal assistance → FEMA + DHS Secretary → presidential declaration → Stafford Act → FEMA mission assignments → ESF activation → ESF-8 (DHHS/ASPR) → medical teams deployed.

QUESTION 2

The National Response Framework replaced the National Response Plan in 2008 to address which primary lesson from Hurricane Katrina?

A. Inadequate pre-event warning systems
B. Bureaucracy and redundancy of the NRP
C. Insufficient federal medical resources
D. Failure of local emergency management

Answer: B

The 2008 NRF replaced the 2004 NRP specifically to address bureaucracy and redundancy revealed by Katrina. The 2013 NRF 2nd edition added the 'whole community' concept (Sandy lesson). The current 4th edition (2019) is now in use.

QUESTION 3

FEMA maintains how many US&R (Urban Search and Rescue) task forces capable of departing in <6 hours?

A. 10
B. 18
C. 28
D. 42

Answer: C

FEMA maintains 28 US&R task forces: 70 members each (search, rescue, technical, medical). Self-sufficient for 96 hours, operational up to 10 days. Medical cache supports 10 critical/15 moderate/25 minor victims plus team members.

99 Prehospital Triage for Mass Casualties

Why Triage Matters

Over-triage overwhelms critical surgical resources; near-linear relationship between over-triage and poor outcomes
Resources shift from individual optimization to population optimization
Triage occurs in three phases: **primary → secondary → tertiary**

Model Uniform Core Criteria (MUCC)

Developed to address lack of interoperability from local-agency triage variation
FICEMS approved MUCC implementation plan in **July 2013**
NHTSA released instructional addendum in **December 2017**
EMS physicians should **actively drive** MUCC transition — revise protocols, conduct SALT training, and track MCI outcomes; passive encouragement is insufficient; the medical director has an active QI responsibility here
Currently in a national transition period toward MUCC-compliant systems

Triage Systems Overview

System	Type	MUCC Compliant	Notes
SALT	All-hazards, all ages	**YES: current standard**	CDC-developed; endorsed by ACEP, ACS-COT, NAEMSP, others
START	Adults	No	Most widely used currently in US
JumpSTART	Pediatric (<8 yo)	No	Based on START; adds rescue breathing for children
Others (CareFlight, Homebush, Triage Sieve, CESIRA, PTT)	Various	Varies	International systems

Triage Categories (MUCC Standard)

Category	Color	Mnemonic	Criteria
Immediate	Red	I	Needs immediate care: respiratory distress, uncontrolled hemorrhage, AMS, unresponsive
Delayed	Yellow	D	Needs care but unlikely to decompensate rapidly; deep lacerations, open fractures, stable abdominal injury
Minimal	Green	M	Self-limited injuries, normal vitals; can tolerate days of delay
Expectant	Gray	E	Alive but likely incompatible with life given available resources; no effort initially
Dead	Black	D	No respirations after basic airway opening

SALT Triage Algorithm

Step 1: Global Sort:
Walk → assess last (Minimal)
Wave/purposeful movement → assess second
Still/obvious life threat → assess first
Step 2: Individual Assessment with Life-Saving Interventions (LSI): If within scope and equipment available:
Control major hemorrhage (tourniquet, direct pressure)
Open airway (positioning, basic adjuncts)
Chest decompression (if tension pneumo suspected)
Auto-injector antidotes (if indicated)
Step 3: Assign Category:
Dead: Not breathing after LSI
Expectant: Obeys commands/purposeful? No → has peripheral pulse? No → respiratory distress? No → hemorrhage controlled? No → IF

injuries incompatible with life given resources → Expectant
Immediate: Any "no" response to the 4 questions (and survivable)
Delayed: All 4 "yes" but NOT minor injuries
Minimal: All 4 "yes" AND only minor injuries

START Triage (Adults: Most Common Currently Used, NOT MUCC-Compliant)

Assessment	Decision
Walk?	Yes → Minor (Green)
Breathing after airway open?	No → Dead (Black)
Respiratory rate	<30/min = Delayed; >30 = Immediate
Perfusion (cap refill >2 sec or no radial pulse)	Yes → Immediate; No → assess mentation
Mental status (follows simple command)	Yes → Delayed; No → Immediate

JumpSTART (Pediatric modification)
Respiratory rate: **15–45/min** (not 10–29 as in START)
5 rescue breaths if apneic but has a pulse → may breathe → Immediate
Uses AVPU scale (Alert/Voice/Pain/Unresponsive)
If no response to rescue breaths with palpable pulse → Immediate
Evaluates infants first

Secondary and Tertiary Triage

Phase	When	Who	Purpose
Secondary	After primary triage; in treatment areas	EM physician, surgeon	Refine priority within categories; upgrade/downgrade based on clinical change or prolonged transport
Tertiary	When scarce resources (vents, OR, ICU beds) exceed demand	Medical directors, public health officials	Allocate critical resources using systematic criteria

Secondary triage systems: SAVE (Secondary Assessment of Victim Endpoint), SORT (System of Risk Triage)
Tertiary triage ethics:
Primary principle: Maximize medical benefit (utilitarianism)
Secondary principles when similar benefit: equal chance (lottery/FCFS: egalitarian) OR social utility (utilitarian, but risk of bias)
COVID-19 ventilator allocation: CDC Ethics Subcommittee recommended multi-principle approach

Population-Based Triage

When casualties are distributed across a community (infectious disease, weather event)
Goal: greatest good for greatest number, PLUS minimize spread/further exposure
Examples: COVID-19 "stay home" guidance, telehealth protocols, "flatten the curve" messaging
Requires EMS medical directors collaborating with public health and elected officials

Triage Tags

Allow bidirectional changes in triage category (clinical condition changes)
If tags unavailable: marking pen on forehead, colored tape on wrist, or physical separation by zone
Tags should fold/tear to allow downgrading as well as upgrading

PRIORITY PATCH

SALT is the only MUCC-compliant triage system; START is most widely used but NOT MUCC-compliant; JumpSTART = pediatric modification of START
MUCC categories: **ID-MED** — Immediate (red), Delayed (yellow), Minimal (green), Expectant (gray), Dead (black)
SALT Step 1: global sort (walk → wave → still); **Step 2**: life-saving interventions (tourniquet, airway, chest decompression, antidotes) — **only if within scope AND equipment available**; **Step 3**: assign category
START respiratory rate cutoff: **<30/min** = delayed; **>30** = immediate; JumpSTART uses 15–45/min and allows **5 rescue breaths** for apneic child with pulse
Tertiary triage primary principle: maximize medical benefit (utilitarianism); secondary when benefit equal: equal chance / lottery (egalitarian — preferred) or social utility (**most ethically dangerous — historically applied with racial/socioeconomic/disability bias**; egalitarian approach preferred when benefit is equivalent)

⚡PULSE CHECK

QUESTION 1

Which triage system is the current MUCC-compliant standard endorsed by CDC, ACEP, ACS-COT, and NAEMSP?

A. START (Simple Triage and Rapid Treatment)
B. JumpSTART (pediatric)
C. SALT (Sort-Assess-Lifesaving Interventions-Treatment/Transport)
D. CareFlight

Answer: C

SALT is the MUCC-compliant current standard endorsed by CDC, ACEP, ACS-COT, and NAEMSP. START (adults) and JumpSTART (pediatrics, <8 yo) are most widely used currently but are NOT MUCC-compliant. The U.S. is in a national transition toward MUCC-compliant systems.

QUESTION 2

In the MUCC triage system, Immediate (Red/I) category criteria include:

A. Ambulatory wounded able to walk to collection area
B. Respiratory distress, uncontrolled hemorrhage, AMS, or unresponsive with survivable injury
C. Injuries incompatible with survival given available resources
D. Deep lacerations or open fractures unlikely to decompensate rapidly

Answer: B

Immediate (Red/I): needs immediate care --- respiratory distress, uncontrolled hemorrhage, AMS, or unresponsive with survivable injury. Delayed (Yellow/D): unlikely to decompensate rapidly. Minimal (Green/M): minor, ambulatory. Expectant (Gray/E): unlikely to survive given available resources.

QUESTION 3

FICEMS approved the MUCC implementation plan in which year?

A. 2006
B. 2010
C. 2013
D. 2017

Answer: C

FICEMS approved MUCC implementation plan in July 2013. NHTSA released an instructional addendum in December 2017. EMS medical directors should actively drive MUCC transition --- revising protocols, conducting SALT training, and tracking MCI outcomes.

100 Mass Casualty Management

Key Definitions

Term	Definition
Disaster	Severity of damage or patient numbers exceeds local responders' ability to manage: requires outside help
Multiple Casualty Incident (MCI, small)	Numerous patients; does NOT overwhelm routing capacity
Mass Casualty Incident (MCI, large)	Large incident requiring multiservice response; overwhelms or threatens to overwhelm local emergency response

Medical Director's Role in MCI

Key concept: The medical director is NOT the scene commander and NOT the primary clinician. They are the **senior medical advisor and liaison.**

Four priorities for the medical director:

Facilitate investment in everyday infrastructure (the best mitigation)
Integrate into interagency command structure
Adapt to an advisory role (not operational)
Continuously advocate for and facilitate multiagency preparedness

The Four Phases of Disaster Management

Phase	Description	Medical Director Role
Mitigation	Reduce disaster likelihood or impact	Seismically resistant facilities; generators above flood lines
Preparedness	Enhance response/recovery capabilities	MCI drills, protocol development, coalition relationships
Response	Save lives, protect property, meet needs	Advisory/liaison to IC; manage medical branch; patient advocacy
Recovery	Restore normalcy after event	Patient tracking, mental health, after-action review

Mitigation and Preparedness Strategy

Common failure points in MCIs:

Communications systems
Resource distribution
Organizational structure

Medical director preparedness activities:

Identify key agencies/personnel → build relationships BEFORE the incident
Develop protocols for daily AND surge operations; train and evaluate
Build scalable data/communications infrastructure
Implement QA to learn from prior incidents

Key stakeholders to engage:

Hospitals and health care facilities
Public health agencies
Fire departments
Law enforcement
Homeland Security
Regional health care networks
VA hospitals
Health care coalitions
Animal control (often overlooked)

MCI Protocol Elements

Protocols should address:
Quantifying and defining an MCI (even small ones can overwhelm an ED)
Dispatch protocols: appropriate resources, communications, supplies

ED and dispatch protocols for active assailant situations
Prearrival instruction to 9-1-1 callers
Role of triage and transportation officers
Triage systems (agency-specific: push toward MUCC compliance)
On-scene transport decision tools (BLS vs. ALS utilization)
Patient distribution among local resources (avoid overwhelming one hospital)
Patient tracking
Continuity of everyday 9-1-1 services
Mutual aid and interagency response
Pediatric considerations (JumpSTART, pediatric equipment, caregiver reunification)
Translation services
Family reunification
Mass fatality response
Spontaneous medical volunteers management
Non-traditional transport (law enforcement, ride-hailing)

Medical Branch of ICS: Three Functions

Function	Key Points
Triage	Start immediately; dynamic process; establish patient collection points and staging areas; simplicity of SALT/START allows EMTs to triage while paramedics treat
Treatment	On-scene care while awaiting transport; "throw kits" (tourniquets, trauma dressings); non-transporting ALS freed to treat while ALS units transport; "Tactical Emergency Casualty Care" principles for active threat
Transport	Distribute patients among facilities; avoid overwhelming single trauma center; noncritical to alternative sites; **continuous real-time hospital capacity feedback loop** — transport officer must know which hospitals are receiving at what capacity and adjust distribution dynamically, not by fixed pre-assignment; account for non-traditional transport already occurring

Resource Escalation

Escalate resource requests through ICS structure early
Mutual aid: neighboring systems take routine calls while local resources handle MCI
Medical director advises IC on type/quantity of additional resources needed

Recovery Phase

Patient tracking and family reunification:
Multiple redundant tracking systems
Google Person Finder, Red Cross Safe and Well, TriagePic
Social media for family reunification
Mental health:
First responders have high rates of PTSD and mental health issues after disasters
Transition involved providers to employee assistance / crisis intervention IMMEDIATELY
Non-mandatory, closed, blame-free debriefing sessions
Psychological first aid training
Mental health support for PATIENTS as well as responders (postevent CISM)
After-action review:
Happens quickly after event while memories are fresh
Fact-finding → structured review → written report → actionable improvement plan
Medical director as translator between public safety and health care systems
Data to gather: 9-1-1/radio comms, ICS structure, patient contacts and times, apparatus response, transport/distribution, supplies adequacy, adverse events, hospital communications

Special Considerations

Health Care Coalitions
Create roundtables for all healthcare partners to share and collaborate
Prevent single-institution bottlenecks; share surge burden
May manage Medical Multi-Agency Coordination Centers (MedMACC)

Medical director should know coalition capabilities and build partnerships

Emerging Technologies
Social media: 1 in 5 survivors contact responders via social media; if 9-1-1 busy, >50% would try digital media
EMS should have 24/7 social media presence (managed by PIO)
Data mining Twitter for "hurt," "trapped," "injured" + incident hashtags → victim location, scene intel
Limitations: malicious attacks, scalability, misinformation spread — false information can misdirect resources to incorrect locations; **PIO must have a social media verification protocol** before acting on social media intelligence

Vulnerable Populations
2007 survey: only 13.3% of EMS agencies had pediatric-specific MCI plans
Children: cognitive/physical limitations, physiologic differences (misdiagnosis/mistriage risk), caregiver reunification needed
Also: technology-dependent patients, dialysis patients, elderly, functional-access-needs patients

PRIORITY PATCH

Medical director role in MCI: **senior medical advisor and liaison** — NOT scene commander, NOT primary clinician
Medical branch of ICS: **three functions** = Triage, Treatment, Transport; simplicity of SALT/START lets EMTs triage while paramedics treat
2005 London bombings: over-triage was reduced when experienced decision makers (EMS physicians) participated in triage
Common MCI failure points: communications systems, resource distribution, organizational structure; best mitigation is investment in everyday infrastructure — most impactful single action: **build interagency relationships before the incident**; systems fail at boundaries between agencies, not within them
Only **13.3%** of EMS agencies had pediatric-specific MCI plans (2007 survey); children need caregiver reunification planning + JumpSTART + pediatric equipment caches

⚡PULSE CHECK

QUESTION 1

The EMS medical director's primary role at a mass casualty incident is:

A. Scene commander directing all rescue operations
B. Primary clinician providing hands-on patient care
C. Senior medical advisor and liaison --- NOT the scene commander or primary clinician
D. Triage officer responsible for all patient categorization

Answer: C

The EMS medical director at an MCI is the senior medical advisor and liaison --- NOT the scene commander and NOT the primary clinician. Four priorities: facilitate infrastructure investment, integrate into interagency command structure, adapt to advisory role, and advocate for multiagency preparedness.

QUESTION 2

Which disaster management phase represents the best long-term investment for saving lives and is emphasized for EMS medical director preparedness efforts?

A. Response --- saving lives during the acute event
B. Recovery --- restoring normalcy after the event
C. Mitigation --- reducing disaster likelihood or impact
D. Preparedness --- enhancing response capabilities

Answer: C

While the medical director plays roles in all phases, mitigation and preparedness are the best investments for long-term outcomes. Common MCI failure points (communications, resource distribution, organizational structure) are all addressable through mitigation and preparedness.

QUESTION 3

What separates a Multiple Casualty Incident (MCI-small) from a Mass Casualty Incident (MCI-large)?

A. Patient count (small <10; large >10)
B. Whether patients exceed routing capacity vs. overwhelm or threaten to overwhelm local emergency response
C. Mechanism of injury
D. Whether federal resources are required

Answer: B

MCI (small): numerous patients but does NOT overwhelm routing capacity. Mass Casualty Incident (large): overwhelms or threatens to overwhelm local emergency response. A disaster requires outside help. These distinctions drive escalation decisions and ICS activation levels.

101 Mass Casualty Evacuation and Patient Movement

Three-Phase Planning Cycle

The three phases form a continuous cycle: **Estimate → Plan → Execute**, then repeat as the situation evolves.

Estimate Phase

Characterize the threat, area, and population to project evacuation requirements.

Components:

Physical characteristics: weather, terrain, geology, hydrology
Transportation nodes, demands, networks (ground/air/sea)
Population density and demographics
Medical institutions (location, structural integrity, electrical backup, patient census)
Casualties: numbers and types
Resources required vs. available

Notice vs. No-Notice Events:

Mass Evacuation: Notice vs. No-Notice Events

	Notice Event (e.g., hurricane)	No-Notice Event (e.g., earthquake)
Pre-event action	Evacuate/shelter-in-place vulnerable patients before impact — **evacuate vs. shelter-in-place is the most critical planning decision**: moving fragile patients through an active storm may be more dangerous than remaining in a structurally sound facility	No time: all response is post-event
Decision factors	Storm strength/direction, facility survivability, flood zone, supplies	Magnitude, soil type, structural damage extent
Patient movement	Both pre- and post-event	Post-event only
Outcome correlation	Planning window available	Time to care = critical mortality predictor

Medical Evacuation Requirements Variables

Compromised medical facilities (structural, utility, staffing)
Incident-related injuries/illnesses
Preexisting conditions (patients in facilities)
Exacerbated problems from care disruption
Vulnerable populations (very young, very old, disabled)

Patient transport factors (for mode selection):

Ambulatory? (Can they walk? Sit? For how long?)
Litter required?
Specialized equipment (oxygen, electrical hookup)?
Continuous care needed?
Risk to self/others?
Chemically contaminated or infectious?

Transportation Modes

Mode	Capacity	Best For	Limiting Factor
Ground ambulance (ALS)	1–2 patients	Short/intermediate (<250 mi)	Oxygen, road conditions
Paratransit	Variable seats (request by seats, not vehicles)	Wheelchair patients; intermediate distances	Road conditions; 250 mi max per FEMA
Rotary wing air ambulance	1 litter typically	Short/intermediate (<150 mi); point-to-point	Weather, oxygen, crew rest (10 hrs/24)
Fixed wing air ambulance	1–2 litters typically	Intermediate/long distances	Same as rotary
Buses	37 ambulatory or 18 litters per bus	Ambulatory patients; intermediate distances	Oxygen limited; need ALS companion unit
Commercial aircraft	Ambulatory, stable patients only	Long distances	FAA-approved equipment only; basic first aid on board
Military (MEDEVAC): UH-60	4 litters, 1 ambulatory	Short/intermediate (<150 mi)	Weather, fuel
Military (C-130) AE-configured	Up to 30+ litters	Long distances (2,361 NM)	20% critical care max per flight (requires CCAT team)
Military (C-17) AE-configured	Up to 36 litters	Long distances (2,400 NM)	Same CCAT requirement for critical patients

CASEVAC: non-medical military platform; no medical personnel or equipment — transportation only.

Planning Phase

A good plan is **simple and flexible.** It addresses:

Operational considerations:

Ingress/egress routes; obstacle identification
Loading/offloading areas; ambulance staging
Casualty collection points (CCPs) and holding areas
Ambulance exchange points (AXPs)
Credentialing of EMS personnel
Site access and security

Clinical considerations:

Triage at CCPs
Emergency and en route care
Time sensitivity (therapeutic windows)

Logistical considerations:

Medical equipment, supplies, resources
Environmental control (heat, water, light)
Food, latrines, blankets, litters, backboards

Command and control:

Unified command including: IC, local dispatch, EMS, hospitals, state/local EOCs, NDMS federal partners, port authorities

Execution Phase

Casualty Collection Points (CCPs):

Safe distance from threat; near transportation networks
Rapid triage + lifesaving treatment + preparation for evacuation
Ambulances colocated or staged nearby
Lanes by triage category when possible
System to communicate with destination hospitals and divide patient volume

Ambulance Exchange Points (AXPs):

Transfer patients from one transport mode to another
Key design requirements: traffic flow access, off-loading areas, medical support, communications, security, landing zones (minimum 30m × 30m)
May serve as HUB for multiple CCPs feeding into longer-distance transport
Federal Coordinating Centers (FCCs) are AXPs for inter-hospital NDMS evacuations

AXP setup: Entry and exit clearly marked with directional signs, traffic cones, and high-conspicuity identification for personnel directing traffic.

NDMS Patient Movement Process

Threatened hospital → PMR (Patient Movement Request) → State EOC
State EOC → Global Patient Movement Requirement Center (GPMRC) at Scott AFB
GPMRC → Tanker Airlift Control Center (TACC) at Air Mobility Command (Scott AFB)

Mission built; crews alerted; aircraft dispatched to airport of embarkation (APOE)
Ambulances transport patients from hospitals to APOE → Disaster Aeromedical Staging Facility (DASF): prepare for flight (exchange equipment, bivalve casts, blankets)
Aircraft flies to airport of debarkation (APOD) → Federal Coordinating Center (FCC): retriage, stage, transport to receiving NDMS hospital
Joint Patient Movement Team: 4-person team deployed to assist the state EOC in reviewing PMRs; validates patients for military aircraft.
DOD has primary responsibility for NDMS patient movement coordination.
FEMA National Ambulance Contract:
Can provide up to 300 ambulances, 3,500 paratransit seats, 25 medically configured aircraft on-scene within **12 hours** of activation

Keys to Successful Mass Evacuation

Estimate: Understand threat, demographics, area, resources, consequences
Plan: Simple, flexible; identify all logistics; address time criticality
Execute and Practice: Know roles; exercise the plan regularly
Hospital mandate: The Joint Commission and CMS require hospitals to have patient evacuation plans AND contracts/agreements with transportation providers.
Individuals with special medical needs should self-evacuate when possible; local plans must provide for those who cannot.

PRIORITY PATCH

Three phases: Estimate (characterize threat/population/resources) → Plan (simple, flexible) → Execute (practice regularly); cycle is continuous
Bus capacity: **37 ambulatory** or **18 litters** per bus; paratransit max **250 miles** per FEMA; rotary wing: **<150 miles** and crew rest 10 hrs/24
Military C-130: up to 30+ litters, range 2,361 NM; C-17: up to 36 litters, 2,400 NM; both require CCAT team for >20% critical patients
NDMS flow: hospital PMR → state EOC → GPMRC (Scott AFB) → TACC → APOE → **DASF** (prepares patients for flight: **bivalved casts, equipment exchange, blankets** — not merely a staging area) → APOD → FCC → receiving NDMS hospital
FEMA National Ambulance Contract: up to **300 ambulances, 3,500 paratransit seats, 25 aircraft** on-scene within **12 hours** of activation

⚡PULSE CHECK

QUESTION 1

Which of the following is identified as the most critical planning decision for a notice event such as a hurricane?

A. Determining receiving hospital surge capacity
B. The evacuate vs. shelter-in-place decision for fragile patients
C. Calculating ambulances needed
D. Coordinating National Guard transportation assets

Answer: B

The evacuate vs. shelter-in-place decision is the most critical planning decision for notice events. Moving fragile patients through an active storm may be more dangerous than remaining in a structurally sound facility. For no-notice events (earthquakes), all response is post-event.

QUESTION 2

The three-phase mass casualty evacuation planning cycle is:

A. Plan → Execute → Recover
B. Estimate → Plan → Execute (then repeat)
C. Assess → Mobilize → Demobilize
D. Prepare → Respond → Restore

Answer: B

Continuous cycle: Estimate → Plan → Execute, then repeat as the situation evolves. The Estimate phase characterizes the threat, area, and population to project evacuation requirements. This cycle continues throughout the event.

QUESTION 3

For no-notice events (earthquakes), patient movement planning differs from notice events because:

A. No-notice events always require air medical resources exclusively
B. All response is post-event; time to care is the critical mortality predictor
C. Shelter-in-place only is required for no-notice events
D. Pre-event planning is irrelevant for no-notice events

Answer: B

No-notice events: no time for pre-event action --- all response is post-event. Time to care is the critical mortality predictor. For notice events (hurricanes), both pre- and post-event patient movement is possible with a planning window available.

102 Temporary Treatment Facilities

Historical Context

Baron Dominique Larrey (Napoleon's Surgeon in Chief): Father of modern military medicine and EMS: developed system to collect wounded and treat in field hospitals (often churches)
Led to: battalion aid stations, casualty clearing stations, modern DMATs
Civilian range: **Casualty collection points** → fully functional EDs (e.g., "Rampart" at Burning Man) → **300-bed National Mobile Disaster Hospital** (FEMA; housed in North Carolina)

Types of Events and Facility Design

Event Type	Key Design Considerations
Planned (mass gathering)	See Ch. 96; type of crowd, alcohol/drug use, environmental conditions, distances to hospitals, security concerns
Notice event (hurricane)	Time to plan and set up; focus on lower-acuity patients; infectious disease cohort separation
No-notice event (tornado, explosion)	Must be rapidly deployed with limited staffing; flexible and scalable; just-in-time training critical

Hospital Surge and Alternate Care Facilities (ACFs)

Surge capacity = ability to manage sudden, unexpected increase in patient volume that would otherwise overwhelm current capacity
Alternate Care Facility (ACF) or "alternate care site": non-ED location for lower-acuity patients
Concept foregrounded by **2009 H1N1 influenza pandemic**; massively expanded during **COVID-19**
COVID-19 examples:
USNS Comfort (NYC) and USNS Mercy (Los Angeles) deployed in 2020: largely underutilized — **hospital ships are designed for trauma, not infectious disease**; shared air and close quarters made them inappropriate for COVID-19 patients; lesson: match facility design to disease type before deployment
Ice rinks, hotels, stadiums converted to care sites
Drive-through testing to reduce ED burden and infection spread
ACF location debate:
On-campus: Easier logistics, resupply, staffing: but risk of overwhelming co-located ED
Off-campus: Decreases ED pressure: but patient transport, public notification challenges
Best practice: Coalition-level projects; a single facility rarely has sufficient staff to run an ACF alone.

Planning and Design Considerations

All temporary facilities need:
Designated ingress/egress for patients, response units, staff
Waiting area, triage area, registration area, medical records
Identification of facility location and hours of operation (public and responders)
Patient tracking system
Emergency decontamination capability
Sanitation (toilets, trash, regulated medical waste management)
Communications (redundancy; satellite phone consideration; telemedicine capability; secure WiFi)

Structure Types

Type	Advantages	Disadvantages
Air-inflatable shelters	Rapid setup	Less rigid; weather-dependent
Rigid-frame tent structures	Can interconnect; expandable	Slower setup
Intermodal shipping containers	Rigid; good for long-term ops; global logistics infrastructure	Heavy; large footprint; complex setup
Fixed structures (schools, arenas)	Weather protection; existing utilities	Structural assessment required; fire alarms may be offline; ADA compliance; competing uses

Pre-survey potential sites in advance: assess space, access, environmental control, backup power, and egress — and fix deficiencies before the need arises.

Staffing Guidelines

For a **10–15 bed treatment area:**
1 physician or advanced practitioner
2 RNs
2 clinical support (paramedic or EMT)
Reduce beds per team for higher acuity
Additional staff needs (scope and duration dependent):
Security, social workers, engineering/maintenance
Respiratory therapy, lab and x-ray technicians
Housekeeping, phlebotomy
Credentialing:
Ideally completed BEFORE deployment
Medical Reserve Corps (MRC): mrc.hhs.gov: pre-screened, trained volunteers
ESAR-VHP (Emergency System for Advanced Registration of Volunteer Health Professionals): phe.gov/esarvhp: state-based, HHS-administered

Equipment Considerations

Need	Key Points
High-acuity care	Code carts, monitoring/telemetry, oxygen, suction, adequate lighting, storage
Isolation/negative pressure	Portable systems available but challenging to deploy
Electrical power	Portable generators with trained operators; backup power critical
Potable water	Minimum 7–10 L/person/day for drinking/cooking/basic hygiene; higher for patients; water purification if infrastructure disrupted
Dialysis	Temporary facilities generally inadequate for dialysis (water pretreatment); focus on restoring existing dialysis center or patient transfer
Pharmaceuticals	Secure storage meeting environmental requirements; CLIA waiver for certain lab tests; pharmacy regulatory compliance
Imaging (X-ray)	Must comply with radiation rules; temporary structures may lack shielding
Medical gases	Bottled gases or on-site production for larger operations

CLIA Waiver: Required from CMS for laboratory testing in temporary facilities; apply in advance.

Level of Care Spectrum

Level	Use Case
Medical shelter	Basic first aid; shelter for medically fragile
Ambulatory clinic	Low-acuity care; frees ED for critical patients
Quarantine unit	Infectious disease cohort management
Lower-acuity inpatient care	Nursing home / hospital overflow
Primary triage/distribution point	Initial sorting before transport
Palliative care facility	End-of-life care when acute resources unavailable
Acute care facility	Near-ED level care; highest complexity; most resources

Demobilization and After-Action

Trigger points for demobilization should be pre-defined:
Level at which existing health care system is functioning
Resources available to meet community needs
After-action report ALWAYS produced when a temporary treatment facility is activated:
What worked?
What needed improvement?
Documentation of patient encounters (liability, future planning)

DMAT and Federal Temporary Facility Assets

DMATs self-sufficient for **72 hours**, typically deploying for **14 days**

Designed to function at fixed or temporary care sites
State-level equivalents exist in Florida, North Carolina, Missouri, Illinois, and others
Pre-designate regular deployment to planned events to maintain staff competency

PRIORITY PATCH

Baron Dominique Larrey (Napoleon's Surgeon in Chief): father of modern military medicine and EMS; developed battlefield treatment system that evolved into DMATs
ACF levels range from medical shelter → ambulatory clinic → quarantine unit → lower-acuity inpatient care → acute care facility; match level to event type and patient acuity
Staffing for **10–15 bed treatment area**: 1 physician/advanced practitioner, 2 RNs, 2 clinical support; coalition projects required — single institution rarely sufficient
CLIA waiver from CMS required for lab testing in temporary facilities; **takes weeks to process — most commonly overlooked pre-deployment step**; applying during an active emergency is impractical; apply in advance; potable water minimum **7–10 L/person/day**
DMATs: self-sufficient 72 hours, deploy within 8 hours, typically 14 days; state-level equivalents exist in FL, NC, MO, IL; demobilization triggers must be pre-defined

⚡PULSE CHECK

QUESTION 1

'Surge capacity' in hospital emergency management is defined as:

A. Ability to increase staff compensation during disasters
B. Ability to manage a sudden, unexpected increase in patient volume that would otherwise overwhelm current capacity
C. Reserve of medical supplies stockpiled for disasters
D. Backup power generation capability

Answer: B

Surge capacity = ability to manage a sudden unexpected increase in patient volume that would otherwise overwhelm current capacity. Alternate Care Facilities (ACFs) --- non-ED locations for lower-acuity patients --- are a key tool. COVID-19 massively expanded ACF use.

QUESTION 2

Baron Dominique Larrey is significant to EMS history because he:

A. Developed the first modern 911 emergency dispatch system
B. Developed a system to collect wounded and treat in field hospitals as Napoleon's Surgeon in Chief
C. Performed the first successful prehospital intubation
D. Authored the 1966 NAS-NRC White Paper

Answer: B

Baron Dominique Larrey (Napoleon's Surgeon in Chief): father of modern military medicine and EMS. Developed the system of field hospitals (often churches) to collect and treat wounded, leading to modern battalion aid stations, casualty clearing stations, and DMATs.

QUESTION 3

The USNS Comfort and Mercy were largely underutilized during COVID-19 because:

A. Staffing was insufficient
B. Hospital ships are designed for trauma, not infectious disease
C. State governors restricted access to federal assets
D. Patient volume was lower than projected

Answer: B

The hospital ships were largely underutilized during COVID-19 because they are designed for trauma care, not infectious disease. COVID-19 required isolation protocols and infection control infrastructure not inherent to the ships' design.

103 Medical Support for Hazardous Materials Response

Background

Hazmat = any matter (solid, liquid, or gas) or energy that when released can harm people, the environment, or property (NFPA 472)
>60,000 chemicals produced annually in the US; >4 billion tons transported yearly; >500,000 hazmat shipments per day
Fixed facility incidents outnumber transportation incidents (~8,700 vs ~4,800 over a 5-year surveillance period); fixed facility incidents cause more injuries
ATSDR's National Toxic Substances Incidents Program tracks hazmat releases with public health consequences
Most incidents in summer; most injuries mid-week, during daylight hours

Identifying Threats and Planning

LEPCs (Local Emergency Planning Committees) = the local conduit for hazmat risk info; created by SARA Title III (Emergency Planning and Community Right-to-Know Act, 1986)
SARA Title III requires regulated facilities to report chemical releases, provide safety data sheets (SDS), and report inventory to LEPCs
Protocols should be developed in conjunction with the medical director, emergency management, local facilities, and poison centers
Key 24-hour resources:
Poison Control: **1-800-222-1222**
CHEMTREC®: **1-800-424-9300 — manufacturer/shipper resource: provides product-specific medical management guidance directly from the manufacturer**; distinct from Poison Control (clinical toxicology) and ATSDR (public health/environmental)
ATSDR: **1-800-232-4636**

Levels of PPE

Level	Protection	Respiratory	When Used
A	Full vapor + splash	Positive-pressure SCBA (fully encapsulating suit)	Hot zone, highest vapor concentration
B	Splash, some vapor	SCBA	High respiratory risk, skin risk lower
C	Splash	Full-face air purification (PAPR, SAR)	Lower air concentrations, less skin risk
D	Minimal	None	No chemical exposure expected

SCBA types: **open-circuit** (most common, compressed air) vs. **closed-circuit** (recirculates, longer duration for mine/tunnel rescue)
Supplied-air respirators (SARs): air via line from distant source; advantage = extended work duration; disadvantage = must retrace steps (within 300 feet), cannot exit by alternate route
Cartridge respirators (PAPRs): inexpensive, no pulmonary function testing needed, battery-limited, cartridge must match vapor type
Physical limitations of PPE: limited dexterity, impaired hearing, heat stress; in Level A, medical care limited to **airway, tourniquet, and auto-injector antidotes**

PPE Health Risks

Heat stress is the primary risk: dehydration, heat cramps, heat stroke
Pre- and post-entry monitoring mandatory (vital signs, weight, pulse oximetry)
NFPA 1584: standard for rehabilitation during emergency operations (rest, cooling/rewarming, rehydration, calorie/electrolyte replacement, monitoring)
Falls (limited vision), hearing impairment, hypothermia (cryogenic materials or cold weather) are secondary risks

Scene Operations

Approach **uphill and upwind** until agent is confirmed
Use Emergency Response Guidebook (DOT/PHMSA) for initial perimeter sizing
Establish incident command early; first arriving unit → single-agency IC → unified command as more agencies arrive
Product identification drives all subsequent decisions (PPE, decon, treatment)
Detection technologies: infrared spectroscopy, ion mobility spectroscopy, flame spectrophotometry, colorimetric tubes/tickets
For radioactive materials: radiation survey meters + personal dosimeters

Decontamination

Triage for decontamination (priority order):
Those exposed to vapors or aerosols

Those exposed to liquid forms
Those with severe complaints or injuries
Clothing removal: Removes ~80% of secondary contamination risk. Cut clothes down the center and roll to the sides. Do NOT pull over the head.
Methods:
Physical removal: brushing (top-down), scraping, vacuuming (HEPA), washing/rinsing, heat/steam
Chemical removal:
Decontamination Methods and Mechanisms

Method	Mechanism
Absorption	Pads/towels soak up chemical
Adsorption	Chemical adheres to adsorbent (e.g., activated charcoal): NOT the same as absorption
Dilution	Water or solvent reduces concentration
Surfactants (soap)	Reduces adhesion; forms micelles with nonpolar compounds
Neutralization	Acids + base → neutral (use cautiously; exothermic)
Degradation	One chemical destroys another
Oxidation	Hydrogen peroxide or oxygen breaks down chemical

Types of decontamination operations:
Rapid mass decon: Immediate, massive water saturation of symptomatic victims; no solutions required initially; dry decon (brushing) if water unavailable or cold weather
Mass decon: Extension of rapid mass for large numbers; water pressure ≤50–60 psi; 3 minutes of exposure; plan for ambulatory and non-ambulatory simultaneously; separate corridors for males and females
Medical decon: Systematic head-to-toe; rinse-wash-rinse cycle; 3–5 min for non-viscous, 5–8 min for viscous/unknown
Technical decon: For personnel exiting hot zone; outer items decontaminated first; water-based only for sealed-seam garments
Emergency decon: Rapid decon for a responder with suit breach or sudden illness; copious water from charged fire hose
PPE during decon: Decon team wears no more than one level lower than the entry team.

Medical Monitoring of Response Personnel

Baseline physical exam before joining team
Annual physical exam while on team
Exit physical exam when leaving team
Exposure-specific exams as needed
Baseline and annual exams include: comprehensive metabolic panel, heavy metal testing, CBC, UA, ECG, CXR, vision, and hearing.

PRIORITY PATCH

Level A: ONLY level with full vapor protection (encapsulating suit + SCBA); **Level C** meets OSHA "first receiver" requirements for hospital decon personnel
Clothing removal eliminates **~80%** of secondary contamination risk; cut down center, roll to sides — do NOT pull over the head
Immediate lifesaving care applies to immediately life-threatening conditions only (airway obstruction, exsanguination, antidotes for symptomatic poisoning) — non-life-threatening care waits until after decon to prevent responder contamination; decon team wears no more than one PPE level below entry team
Rapid mass decon: copious water at **≤50–60 psi**, **3 minutes** exposure; medical decon: rinse-wash-rinse, 3–5 min non-viscous, 5–8 min viscous/unknown
Adsorption (chemical adheres to adsorbent) ≠ Absorption (material soaks into pad); lipid-soluble agents absorb through skin; water-soluble agents absorb through mucous membranes

⚡PULSE CHECK

QUESTION 1

Which 24-hour resource provides product-specific medical management guidance directly from manufacturers?

A. ATSDR (1-800-232-4636)
B. Poison Control (1-800-222-1222)
C. CHEMTREC (1-800-424-9300)
D. FEMA EOC via radio

Answer: C

CHEMTREC (1-800-424-9300) provides product-specific medical management guidance directly from manufacturers/shippers. Poison Control (1-800-222-1222) handles clinical toxicology. ATSDR (1-800-232-4636) handles public health and environmental concerns. These are distinct and complementary.

QUESTION 2

Local Emergency Planning Committees (LEPCs) were created by which legislation?

A. Stafford Act
B. SARA Title III (Emergency Planning and Community Right-to-Know Act, 1986)
C. National Response Framework (2008)
D. OSHA 29 CFR 1910.120

Answer: B

LEPCs were created by SARA Title III (1986), which also requires regulated facilities to report chemical releases, provide Safety Data Sheets (SDS), and report inventory to LEPCs. LEPCs are the local conduit for hazmat risk information.

QUESTION 3

Comparing fixed facility vs. transportation hazmat incidents: which causes more injuries?

A. Transportation incidents cause more injuries despite fewer occurrences
B. Fixed facility incidents outnumber AND cause more injuries than transportation incidents
C. Both cause equal numbers of injuries
D. Transportation incidents outnumber and cause more injuries

Answer: B

Fixed facility incidents outnumber transportation incidents (~8,700 vs. ~4,800 over 5 years) AND cause more injuries. Tracked by ATSDR's National Toxic Substances Incidents Program. Most incidents occur in summer, mid-week, during daylight hours.

104 Chemical Properties of Hazardous Materials

Types of Contamination

Exposure: Contact with a hazardous material (may or may not result in contamination)
Primary contamination: Direct transfer of material from source to person/object
Secondary contamination: Transfer from a contaminated person/object to another: most common mechanism for health care worker contamination — **prevention of secondary contamination is the medical director's primary hazmat responsibility**; most provider contamination occurs from inadequate field decon before hospital arrival, not from direct scene exposure
Overt exposure: Obvious contamination or rapid symptom onset (e.g., sarin, caustics)
Covert exposure: No immediate awareness (e.g., biologic agents with incubation period)

Categories of Hazardous Materials (CBRN/CBRNE)

Category	Exposure Type	Decontamination	Notes
Chemical	Usually **overt**	Formal decon usually required	Morbidity depends on physical properties
Biological	Almost always **covert**	Usually already done (showered at home)	Consider prophylactic treatment for exposed responders
Radiological/Nuclear	Variable	Mechanical removal (soap/water)	Decon does NOT take priority over treatment
Enhanced conventional/Explosives	Overt	Blast injury management	Thermobaric weapons cause greater blast

States of Matter and PPE Implications

State	Key Property	PPE	Decon
Solid	Melting point; large solids less mobile	Level D (+ particulate mask)	Remove/brush off; soap and water for small particles
Liquid	Boiling point; can be absorbed through skin/mucous membranes	Level C	Critical: skin and mucous membrane absorption risk
Gas	Density vs. air (determines if settles or disperses); secondary contamination rare unless absorbed by porous material	Level A or B	Remove from source; remove off-gassing clothing
Aerosol	Mass determines suspension time; behaves like gas; most dangerous	Level A (minimum)	Full decon with soap and water

Solubility

"Like dissolves like": polar dissolves polar, nonpolar dissolves nonpolar
Skin: Lipid bilayer → **water-soluble (polar)** molecules *less* likely to absorb through skin; **lipid-soluble (nonpolar)** molecules *more* likely
Mucous membranes: Opposite: water-soluble molecules absorbed more easily
For decon: polar contaminants → water alone may suffice; nonpolar contaminants → need soap (emulsificant) to form micelles

Acids and Bases

Rapid symptom onset → early detection
Decontamination endpoint: wash with copious water until skin pH returns to neutral

Key Reference Resources

Emergency Response Guidebook ("orange book"): phmsa.dot.gov
WISER (hazardous substance properties): wiser.nlm.nih.gov
CHEMM (chemical hazmat management): chem.nlm.nih.gov
REMM (radiation incident management): remm.nlm.gov

PRIORITY PATCH

Key physical property by state: **melting point** (solids), **boiling point** (liquids drives evaporation rate and vapor hazard), **density relative to air** (gases — **denser than air settles in low areas; lighter than air rises**: determines evacuation direction and where responders should position); aerosols = most dangerous — hardest to contain, most likely to reach mucosa
Lipid-soluble (nonpolar) agents absorb through skin; water-soluble (polar) agents absorb through mucous membranes — decon strategy differs accordingly
Biological agents: almost always **covert** exposure; decon usually already done (patient showered at home); **EMS may be first to recognize a biological event through pattern recognition** — multiple patients with similar symptom clusters presenting over days, not a single scene event; consider prophylactic treatment for exposed responders
Radiological: decon does **NOT** take priority over treatment; mechanical removal (soap/water) only — radioactivity cannot be chemically neutralized
Key references: Emergency Response Guidebook (phmsa.dot.gov), WISER (wiser.nlm.nih.gov), CHEMM (chemm.nlm.nih.gov), REMM (remm.nlm.gov)

⚡PULSE CHECK

QUESTION 1

The EMS medical director's primary hazmat responsibility is prevention of which contamination type?

A. Primary contamination from direct source exposure
B. Secondary contamination of health care workers
C. Environmental contamination from runoff
D. Airborne contamination of bystanders

Answer: B

Prevention of secondary contamination of health care workers is the medical director's primary hazmat responsibility. Most provider contamination occurs from inadequate field decontamination before hospital arrival --- not direct scene exposure.

QUESTION 2

Which hazardous material category typically presents as a covert exposure without immediate symptom onset?

A. Chemical agents (e.g., sarin)
B. Radiological materials
C. Biological agents
D. High-order explosives

Answer: C

Biological agents are almost always covert --- victims typically have no immediate awareness and have often already showered by the time they present for care. Chemical agents are usually overt (immediate symptoms). This drives different response strategies.

QUESTION 3

Which hazmat state of matter typically requires formal decontamination, with morbidity depending on physical properties?

A. Solid
B. Chemical (liquid/gas)
C. Biological
D. Radiological

Answer: B

Chemical (liquid/gas) hazmat typically requires formal decontamination. Morbidity depends on physical properties (volatility, viscosity, reactivity). Biological: decon is usually already done (patient showered). Radiological: mechanical removal; decon does NOT take priority over treatment.

105 Radiological and Nuclear Response

Radiation Basics

Nonionizing radiation: Excites atoms/molecules (not directly relevant here)
Ionizing radiation: Removes electrons, creates free radicals, breaks DNA bonds → acute radiation syndrome or local tissue damage
Types and penetration:
Ionizing Radiation Types — Penetration and Shielding

Type	Penetration	Shielding
Alpha	Stops at skin/paper	Clothing sufficient; danger if ingested
Beta	~1 cm of flesh	Firefighter gear adequate
Gamma/X-ray	Deep tissue	Lead, concrete, water required
Neutron	Deep tissue	Plastic and water required

Background radiation is ubiquitous and has always existed; radon accounts for >50% of US background exposure

Three Types of Radiation Exposure

Irradiation: Radiation field passes through the body: no residual contamination
Contamination: Radioactive material on the outside of the body: mechanically removable
Internal exposure (ingestion): Radioactive material enters the body via inhalation, ingestion, or wounds: **most dangerous**; element concentrates in specific organs (iodine → thyroid, calcium → bone)

Protection: Time, Distance, Shielding

Time: Radiation effects are linearly cumulative: half the time = half the dose
Distance: Inverse square law: doubling distance reduces exposure by 75% (quarter the dose)
Shielding: Dense materials best; even a co-worker's body provides some gamma shielding

EPA Emergency Action Dose Guidelines

Dose	Activity
5 rem (0.05 Sv)	All activities
10 rem (0.1 Sv)	Protecting major property
25 rem (0.25 Sv)	Lifesaving / protecting large populations
>25 rem (>0.25 Sv)	Lifesaving only: volunteers who understand the risks

Note: 1 rem = 10 mSv; 1 Sv = 100 rem

Decontamination of Radioactive Material

Radioactivity cannot be "denatured" chemically: only **mechanical removal** works
Removing clothing removes most contamination (Pacific fallout data)
Wash exposed skin with soap and water or chelating agents
Prevent ingestion via respiratory tract: always wear N-95 or greater mask when radioactive airborne contamination is possible
If drinking in a contaminated area, use a **straw** to prevent washing contaminants from lips into the body

Signs and Symptoms of Radiation Exposure

Dose	Prodrome	Lymphocytes at 24h	CNS
0–100 rad	None	Unaffected	No impairment
100–200 rad	N/V in 5–50%	Minimally decreased	No impairment
200–600 rad	N/V in 50–100% (onset 1–4h)	<1,000	Cognitive impairment 6–20h
600–800 rad	N/V in 75–100% (<1h)	<500	Cognitive impairment >24h
600–3,000 rad	N/V in 90–100% (minutes)	Decreases within hours	Rapid incapacitation
>3,000 rad	100%, minutes	Decreases within hours	Rapid incapacitation

Andrews lymphocyte nomogram: Use serial lymphocyte counts to estimate degree of radiation exposure **Bone marrow suppression:**

Maximal ~30 days post-exposure (greatest infection risk) **LD50:** ~200–300 rem; associated with rapid N/V and ALC <500 at 24 hours

Dirty Bombs (Radiological Dispersal Devices)

Primary danger = blast/trauma, not radiation
Dispersal of radioactive material → diluted → reduced field strength at distance
Greatest operational challenge = **overwhelmed system by "worried-well"** public
Strategy for worried-well: bag their clothes, shower at home, bring clothes to a check station

Nuclear Weapon Effects (Energy Distribution)

35% thermal (infrared pulse): causes spontaneous combustion at near-field (10 cal/cm²)
50% blast (atmospheric displacement)
5% immediate ionizing radiation (prompt gamma)
10% fallout
Initial fallout (24–48h): 50–70% of total radioactivity; extremely hazardous → **shelter in place** as far from exterior as possible
Late fallout: smaller particles, longer half-lives, descends over days/weeks
Flash blindness: Blink reflex ~200 ms may be insufficient; permanent damage can occur
EMP (electromagnetic pulse): Can damage all electronic circuits, communications, medical equipment

Three Myths That Paralyze Medical Response

"Radioactive contamination is highly dangerous" → **False:** Not immediately dangerous to life; unlike chemical/biological agents, presents little hazard to staff unless ingested
"Decontamination is the highest medical priority" → **False:** Treat the patient; decontaminate after
"Special skills are needed to treat radioactive patients" → **False:** Radiation meters are easy to use; decon is soap and water
These three myths are the most common reason EMS providers fail to treat radiation patients — recognizing and correcting them is a medical director education responsibility.

PRIORITY PATCH

Radiation protection: **Time** (half time = half dose), **Distance** (double distance = 75% dose reduction via inverse square law), **Shielding** (dense materials best)
Radioactive contamination is **NOT** an immediate threat to providers as long as material stays outside the body; **ingestion is the greatest hazard**; treat first, decontaminate after
Andrews lymphocyte nomogram: serial ALC estimates radiation dose; **ALC <500 at 24h** = severe exposure; bone marrow suppression maximal at ~**30 days** (peak infection risk → drives antibiotic prophylaxis and isolation protocols)
Internal exposure: iodine concentrates in thyroid — most clinically important internal exposure; **potassium iodide (KI)** given to block thyroid uptake; only effective if given before or immediately after exposure
Dirty bomb (RDD): primary danger = blast/trauma, NOT radiation; greatest operational challenge = overwhelming "worried-well" surge; bag clothes, shower at home, check station for contamination
Nuclear weapon: 50% blast, 35% thermal, 10% fallout, 5% prompt gamma; initial fallout (24–48h) is 50–70% of total radioactivity → **shelter in place**, interior rooms, away from windows

⚡PULSE CHECK

QUESTION 1

Which type of radiation is most dangerous when radioactive material enters the body via inhalation, ingestion, or wounds?

A. Alpha radiation
B. Beta radiation
C. Gamma radiation
D. Neutron radiation

Answer: A

Internal alpha exposure is the most dangerous --- alpha particles cause extensive ionization within tissues. Externally, alpha particles are stopped by skin and pose no hazard. Internally (from inhalation/ingestion/wounds) they cause the greatest biological damage.

QUESTION 2

The inverse square law for radiation: doubling distance reduces exposure by:

A. 50%
B. 67%
C. 75%
D. 90%

Answer: C

Inverse square law: doubling distance reduces exposure by 75% (to one quarter). Distance is one of the three primary radiation protection principles: Time, Distance, and Shielding.

QUESTION 3

EPA emergency action guidelines allow lifesaving activities at a radiation dose of up to:

A. 5 rem (0.05 Sv)
B. 10 rem (0.1 Sv)
C. 25 rem (0.25 Sv)
D. 10 Sv

Answer: C

EPA Emergency Action Guidelines: 5 rem = all activities; 10 rem = protecting major property; 25 rem = lifesaving or protecting large populations. Background radiation accounts for approximately 50% of U.S. exposure, mostly from radon.

106 Weapons of Mass Destruction

Definition and Context

WMD (U.S. law): designed to cause death or serious bodily injury via toxic/poisonous agents, biological agents, or radiation at levels dangerous to human life; also includes destructive devices (explosives, incendiaries)
First modern non-state WMD use: Aum Shinrikyo sarin attacks in Matsumoto (1994) and Tokyo subway (1995) → thousands of casualties, 11 deaths; EMS responders were among the injured
WMD categories: **C**hemical, **B**iological, **R**adiological, **N**uclear, **E**xplosive (CBRNE)

Three Unique Aspects of WMD Events

Intent: Perpetrators want casualties; secondary devices targeting responders are a real threat. EMS clinicians are high-risk targets
Magnitude: Hundreds to thousands of casualties; medical systems easily overloaded; unusual antidotes needed in large quantities
Forensics: Bodies and victims may be evidence; chain of custody matters; pre-event coordination with law enforcement essential

Secondary Device Threats

Device	Building Evacuation	Outdoor Evacuation
Small package/letter (1 lb)	40 ft	900 ft
Pipe bomb (5 lb)	70 ft	1,200 ft
Vest/container (20 lb)	110 ft	1,700 ft
Compact car (500 lb)	320 ft	1,900 ft
Full-size car (1,000 lb)	400 ft	2,400 ft
Van/SUV (4,000 lb)	640 ft	3,800 ft
Delivery truck (10,000 lb)	860 ft	5,100 ft

EMS Preparation for WMD Response

Foundation: MCI principles, hazmat/decontamination, infection control and self-care
Beyond MCI: scene safety in the context of secondary devices and intentional harm
Equipment includes ballistic vests, helmets, eye protection, cover
Specialized supplies: large quantities of atropine for nerve agents (**nerve agent MCIs require 20+ mg atropine per patient** — far exceeding typical EMS supply of 4–8 mg; pre-positioned caches are mandatory, not optional), radiological antidotes, mass trauma supplies, antibiotics
Pre-solve controlled substance authorization issues (opioids, benzodiazepines for field use)
OSHA 3370: EMS employers must prepare for "reasonably anticipated worst case scenario"
Altered standards of care and **alternate patient destinations** may apply: must be part of pre-event planning

PRIORITY PATCH

WMD = **CBRNE**: Chemical, Biological, Radiological, Nuclear, Explosive; first modern non-state use: Aum Shinrikyo sarin attacks, Tokyo subway 1995
Three unique WMD aspects: Intent (secondary devices target responders), Magnitude (hundreds to thousands of casualties), Forensics (victims/bodies are evidence; chain of custody)
EMS physician must be involved in **pre-event planning**; "just-in-time" training alone is insufficient for the physician leadership role
Large-quantity antidotes needed pre-positioned: **atropine** for nerve agents (**20+ mg/patient required in nerve agent MCI vs. 4–8 mg typically stocked**; pre-positioned caches mandatory), radiological antidotes, mass trauma supplies; controlled substance authorization issues must be pre-solved
OSHA 3370: EMS employers must prepare for "reasonably anticipated worst-case scenario"; altered standards of care and alternate destinations require pre-event planning
Secondary device standoff distances (most tested): pipe bomb = 70 ft building / 1,200 ft outdoor; van/SUV = 640 ft / 3,800 ft; **EMS does not advance until law enforcement clears secondary device threat**

⚡PULSE CHECK

QUESTION 1

The Aum Shinrikyo sarin attacks were historically significant because:

A. They were the first government-sponsored chemical weapons attacks
B. They were the first modern non-state WMD use, with thousands of casualties
C. They demonstrated that sarin is ineffective as a mass casualty agent
D. They prompted creation of FEMA's WMD response framework

Answer: B

Aum Shinrikyo (Matsumoto 1994, Tokyo subway 1995) were the first modern non-state WMD use --- thousands of casualties, 11 deaths. EMS responders were among the injured. These events established WMD response as an EMS/emergency medicine priority.

QUESTION 2

The recommended outdoor evacuation distance for a compact car-sized vehicle bomb (~500 lb explosive) is approximately:

A. 200 feet
B. 900 feet
C. 1,900 feet
D. 5,100 feet

Answer: C

Compact car (500 lb): outdoor evacuation 1,900 feet; building evacuation 320 feet. Van/SUV (4,000 lb): outdoor 3,800 feet. Delivery truck (10,000 lb): outdoor 5,100 feet. These evacuation distances are directly testable.

QUESTION 3

Which unique WMD aspect specifically increases danger to EMS responders compared to conventional MCIs?

A. Large patient numbers overwhelm EMS resources
B. Secondary devices targeting responders are a real threat; EMS clinicians are high-risk targets
C. Unusual antidotes are unavailable in EMS systems
D. WMD victims are more medically complex than typical trauma patients

Answer: B

Three unique WMD aspects: (1) Intent --- perpetrators want casualties; secondary devices target responders; (2) Magnitude --- unusual antidotes needed in large quantities; (3) Forensics --- bodies/victims may be evidence. Secondary devices make EMS high-risk targets.

107 Tactical Emergency Medical Support (TEMS)

Background

TEMS = provision of preventive, urgent, and emergent medical care during high-risk, extended-duration, mission-driven law enforcement special operations
NAEMSP endorsed integrating TEMS into tactical teams in 2001; also supported by National Tactical Officers Association (NTOA)
Historical gap: in 1989–1990, most tactical teams had only a civilian ambulance on standby with no tactical training and no medical direction
Goals of TEMS programs: enhance mission accomplishment, reduce liability, diminish disability costs, maintain team morale

Why Standard EMS Cannot Substitute for TEMS

Hostile conditions endanger untrained/unequipped EMS personnel
Controlled entry: non–law enforcement may be denied access
Even urban scenes may be functionally austere
Operational security requires TEMS personnel to know the mission plan

Zones of Care

Zone	Threat Level	Medical Priorities	TCCC Equivalent
Hot zone	Active/immediate threat	Extrication, tourniquet for exsanguinating hemorrhage only	Care Under Fire
Warm zone	Potential/indirect threat	Risk/benefit; **MARCH** (Massive bleed control, Airway, Respiratory, Circulation, Hypothermia)	Tactical Field Care
Cold zone	No significant danger	Full EMS-equivalent care; reassess prior interventions	TACEVAC (Tactical Evacuation Care)

Less-Lethal Weapons

Weapon	Key Points	Medical Concerns
OC (oleoresin capsicum / pepper spray)	Hot pepper derivative	Burning mucous membranes; treat with water irrigation; resolves in 30–60 min
CS (tear gas)	Synthesized chemical irritant	Similar to OC; treat with moving air; rarely causes true bronchospasm
Kinetic impact projectiles (rubber bullets, beanbags)	Large, slow, distribute force	Can penetrate skin; evaluate for solid organ injury, occult fractures; **commotio cordis** possible with precordial impact → have AED available
NFDD / flashbang	Noise + flash to disorient	Blast trauma, TM rupture, burns; ignition risk
CEW / TASER	0.36 J per pulse, up to 50,000 V, 19 pulses/sec for 5 seconds	Puncture wounds, blunt trauma falls; VF risk ~1 in 2.5 million exposures; 99.7% have mild or no injuries

Excited Delirium

Acute onset bizarre/violent behavior, paranoia, hyperthermia, extraordinary strength, incoherent shouting
Associated with stimulant drug abuse or psychiatric illness
Medical emergency: risk of cardiorespiratory arrest post-restraint
Management: avoid prone positioning, active cooling, aggressive IV fluids, chemical restraint (benzodiazepines, antipsychotics, ketamine), ALS transport

Unique TEMS Skills

Commander's medical conscience: TEMS physician advises command on health/welfare of team and public
Medical threat assessment: Evaluates health hazards of planned operation, local resources, evacuation plans
Remote assessment methodology: Assess and direct care from a distance when direct access unsafe
Medicine across the barricade: Telephone/radio-guided assessment through negotiator; never agree to demands, make promises, or enter barricaded area
Sensory-deprived/overload assessment: Physical exam skills using non-visual senses

Hasty decontamination: Field-expedient decon, especially for clandestine drug lab operations

Physician Roles in TEMS

Medical director only: A few hours/month; protocol/policy oversight
Operational team member: Full deployment commitment; broader scope of practice may be lifesaving; can manage sick call/preventive care
Combination

Controversies

Issue	Sworn Officer	Civilian
Sworn vs civilian medics	Fewer security/evidence concerns; possible role confusion	More medical expertise; requires tactical training
Armed vs unarmed	Firearms typically required for sworn officers	Liability and training concerns for civilians

PRIORITY PATCH

MARCH (warm zone priorities): Massive bleeding → Airway → Respiratory → Circulation/shock → Hypothermia; some add second **H** for Head injury
XABC equipment priority: e**X**sanguination control, **A**irway, **B**reathing, **C**irculation; cardiac/code drugs generally NOT carried (CONTOMS: no medical cardiac arrests in 679 reports from 4,139 incidents)
Three zones: Hot (extrication + tourniquet only = Care Under Fire) → Warm (MARCH = Tactical Field Care) → Cold (full EMS care = TACEVAC)
Excited delirium: medical emergency — avoid prone positioning, active cooling, aggressive IVF, chemical restraint (benzos/antipsychotics/ketamine), ALS transport
CEW/TASER: 0.36 J per pulse, 19 pulses/5 sec; VF risk ~1 in 2.5 million exposures; **commotio cordis** from kinetic impact projectiles → **AED must be physically present at all tactical events**, not staged at cold zone (latency would be fatal)
Medicine across the barricade: TEMS physician assesses *through* the negotiator only — never becomes the negotiator; never enters the barricaded area; never agrees to demands or makes promises regardless of clinical urgency

⚡PULSE CHECK

QUESTION 1

In TEMS/TCCC, the warm zone (tactical field care phase) allows which medical interventions?

A. Position only --- no procedures
B. Full EMS-equivalent care identical to cold zone
C. MARCH protocol (Massive hemorrhage control, Airway, Respiratory, Circulation, Hypothermia)
D. ETI and IV RSI only

Answer: C

Warm zone (indirect threat) = tactical field care. MARCH protocol: Massive hemorrhage, Airway, Respiratory, Circulation, Hypothermia. Hot zone (direct threat) = care under fire: extrication + tourniquet for exsanguinating hemorrhage ONLY. Cold zone = full EMS-equivalent care.

QUESTION 2

Which of the following correctly describes why standard EMS cannot be substituted for TEMS?

A. Standard EMS providers are not medically qualified
B. Hostile conditions, controlled entry, operational security, and functionally austere environment require tactical training
C. Insurance liability prevents standard EMS from operating at tactical scenes
D. Standard EMS lacks necessary medical equipment

Answer: B

Standard EMS cannot substitute for TEMS: hostile conditions endanger untrained/unequipped providers, controlled entry may deny non-law enforcement access, operational security requires knowing the mission plan. In 1989--90, most tactical teams had only an untrained ambulance on standby.

QUESTION 3

NAEMSP first endorsed integrating TEMS into tactical teams in which year?

A. 1989
B. 1995
C. 2001
D. 2009

Answer: C

NAEMSP endorsed TEMS integration in 2001, also supported by the National Tactical Officers Association (NTOA). TEMS goals: enhance mission accomplishment, reduce liability, diminish disability costs, and maintain team morale.

108 Technical Rescue, Confined Space, and Limited Access Situations

Technical Rescue Domains (NFPA 1006)

Tower, Rope, Structural Collapse, Vehicle, Animal, Wilderness, Trench, Machinery, Cave, Mine/Tunnel, Helicopter, Surface Water, Swiftwater, Dive, Ice, Surf, Watercraft, Flood Rescue

Three training levels (NFPA 1670): Awareness → Operations → Technician

Urban Search and Rescue (US&R)

FEMA network: 28 US&R task forces; each can depart in <6 hours, self-sufficient for 96 hours, operational up to 10 days

Each team: 70 members (search, rescue, technical, medical)

Medical cache: temporary care for 10 critical / 15 moderate / 25 minor victims + team members + search dogs

Medical team manager: EMS physician role; also ensures immunizations, cache maintenance, basic veterinary care, food/beverage safety, liaison to local EMS and hospital system

Confined Space Medicine (CSM)

CSM = care of victims in collapsed structures or similar environments with limited access, egress, and unfavorable conditions

Goal: sophisticated medicine in an austere environment

Brings EMS, emergency medicine, and critical care **to** the patient, rather than the reverse

Unlike conventional EMS, **prolonged on-scene time** with the patient is expected and required

8 Components of CSM Practice:

Gather patient data early (bystanders, voice contact before physical contact)

Monitor the effect of rescue efforts on the patient (CO from gas-powered tools, dust)

Preposition likely needed equipment (rope haul systems, medications)

Begin physical assessment at first contact (talking patient = patent airway, intact ABC)

Initiate stabilization (dust mask, face shield, helmet): only IV/O2 if clinically indicated

Provide anatomical/physiological advice to rescue team for patient movement

Reevaluate after each significant move (especially if intubated)

Prepare patient for handoff to local EMS

Rescuer Safety

OSHA "permit-required confined space" = space that:

Contains or could contain a hazardous atmosphere

Could engulf an entrant

Has converging/tapering walls that could trap

Contains other recognized health or safety hazards

Monitor for oxygen content, flammability, toxicity before and during entry

Maintain continuous contact with an attendant (visual, phone, or radio)

Nitrogen asphyxiation: ~8 deaths/year in US from nitrogen-rich/oxygen-poor environments; ~20% of fatalities from nitrogen/air tank mix-up; always suspect when rescuer collapses trying to rescue victim

EMS physicians must NOT enter permit-required confined spaces without complete training, appropriate equipment, and authorization through ICS

Common CSM Clinical Problems

Crush injury → compartment syndrome → crush syndrome (see Chapter 34)

Blast injuries (see Chapter 32)

Dust airway impaction: silica, asbestos, calcium from building materials; rescue operations (power saws) can resuspend particles; humidified O2 helpful

Prolonged care: patients may be in acute exacerbation of chronic conditions (antihypertensives, insulin, seizure meds, psych meds)

PRIORITY PATCH

OSHA: "planning to rely on the 911 phone number... would **not** comply" with permit-required confined space regulations; pre-plan rescue services before entry
EMS physicians must **NOT** enter permit-required confined spaces without complete training, appropriate equipment, and ICS authorization
FEMA US&R task forces: **28** teams; self-sufficient **96 hours**, operational up to 10 days; each team 70 members; can depart in <6 hours
Nitrogen asphyxiation: ~8 deaths/year in U.S.; ~20% of fatalities from nitrogen/air tank mix-up; when rescuer collapses trying to save a victim → suspect atmospheric hazard
CSM distinguishes from conventional EMS: prolonged on-scene time expected; brings critical care to the patient; monitor effect of rescue tools on patient — **CO from gas-powered rescue tools is the most commonly overlooked CSM hazard**; the rescue effort itself can worsen the patient's condition

⚡PULSE CHECK

QUESTION 1

Which NFPA standard governs the technical rescue training levels of Awareness, Operations, and Technician?

A. NFPA 1006
B. NFPA 1500
C. NFPA 1670
D. NFPA 1582

Answer: C

NFPA 1670 governs the three technical rescue training levels: Awareness → Operations → Technician. NFPA 1006 defines the technical rescue domains. NFPA 1500 covers occupational safety and health.

QUESTION 2

FEMA US&R task forces can depart in under 6 hours and are self-sufficient for how long?

A. 24 hours
B. 48 hours
C. 96 hours
D. 10 days

Answer: C

FEMA US&R task forces: depart <6 hours, self-sufficient for 96 hours, operational up to 10 days. Each has 70 members and a medical cache supporting 10 critical/15 moderate/25 minor victims plus team members.

QUESTION 3

The EMS physician role in a FEMA US&R task force is best described as:

A. Primary rescuer for technically complex extractions
B. Medical team manager --- ensuring immunizations, cache maintenance, basic veterinary care, food safety, and liaison to local EMS and hospitals
C. Online medical director only --- no field presence required
D. Incident commander during mass casualty medical operations

Answer: B

The EMS physician serves as medical team manager: ensures team immunizations, medical cache maintenance, basic veterinary care for search dogs, food/beverage safety, and liaison to local EMS and hospital system.

109 Wilderness EMS

Definitions

Wilderness: Any area where fixed or transient geographic challenges alter the requirements for, or availability of, medical or patient movement resources: includes deserts, mountains, caves, and even urban areas during disasters
Wilderness medicine: Medical care delivered in wilderness areas (often unexpected/opportunistic)
WEMS: Systematic and preplanned delivery of wilderness medicine by formal health care practitioners within the defined EMS system: increased duty to act and medicolegal expectations vs. general wilderness medicine

Levels of Wilderness Medical Certification

Level	Training Hours	Scope
Wilderness First Aider (WFA)	16–24 hrs	Basic first aid
Wilderness First Responder (WFR/WEMR)	60–80 hrs	Life-threatening illness/injury, some medication administration, some protocol application
Wilderness EMT (WEMT)	120–200 hrs EMT + 48–80 hrs wilderness	WFR + full EMT-Basic scope
Wilderness Paramedic	WFR + EMT-P	All paramedic + extended procedures (Foley, etc.)
Wilderness Physician	Full physician training	Advanced decision-making within environmental limitations

Key WEMS Protocol Areas (Differing from Traditional EMS)

1. Wound Care
Wound irrigation, ongoing wound assessment, foreign body removal when needed for evacuation or infection risk
Antibiotic prophylaxis protocols appropriate for prolonged extrication
Tourniquet training even more critical given delays to definitive care
2. Termination of Resuscitation (TOR)
Wilderness Medical Society: CPR may be discontinued after ~30 minutes without ROSC (even without monitor to confirm nonorganized rhythm)
Do NOT start CPR for: obvious signs of death, frozen chest wall, ice in airway, cold water submersion known >60 minutes, or when CPR would place rescuers in excessive danger
BLS TOR Rule (Verbeek): arrest not witnessed by EMS + no shockable rhythm + no ROSC before transport → 99.5% positive predictive value for death, 90% specificity for survivors
3. Joint Reductions
Shoulder, digit, and patella: especially dislocations from indirect trauma
Shoulder reduction can allow patient to self-extricate, reducing rescuer risk
Only 9 states permit traditional EMS practitioners to perform joint reductions
4. Spinal Cord Protection
2013: NAEMSP + ACS Committee on Trauma → long board immobilization benefit largely unproven; use should be judicious
2018: ACEP + NAEMSP + ACS → term "spinal motion restriction (SMR)" endorsed; long spine board not required for SMR
2019: Wilderness Medical Society → recommends **against** rigid cervical collars or rigid backboards in any EMS environment
In wilderness: immobilized patient on backboard may be less able to avoid environmental hazards (flash floods, avalanches); dramatically complicates evacuation logistics
5. Anaphylaxis and Severe Asthma
Epinephrine for life-threatening anaphylaxis/asthma at all appropriate provider levels
Wilderness protocols may also include albuterol MDI, prednisone/dexamethasone, diphenhydramine, famotidine
Studies: BLS practitioners correctly identify anaphylaxis and use epinephrine correctly 95% of the time
Freeze-thaw study: epinephrine autoinjectors retain bioavailability after multiple freeze-thaw cycles

Protocols Unique to WEMS

Parameters for search and rescue (when to scale back or transition from rescue to recovery)
Autonomous operation protocols (for areas with poor communications and no direct medical oversight)
Communications: VHF, UHF, satellite personal locator beacons (PLBs); 3G cellular coverage now on Mt. Everest summit

WEMS Equipment (Not Typically Available in Traditional EMS)

Portable hyperbaric bags (Gamow bag for altitude illness)
High-altitude/tactical rescue helicopters; short-haul patient extrication

Stokes baskets, rope/rigging systems (cave, water, high-angle)
Atypical transport platforms: off-road ambulances, toboggans, rescue sleds, horses/mules, ATVs, drones

Emerging WEMS Areas

Intranasal fentanyl and ketamine
Oral dissolving opioids (sufentanil sublingual)
Field administration of snake antivenin
Minimum fitness standards for SAR team members

PRIORITY PATCH

Wilderness = any area where geography alters requirements for or availability of medical/patient movement resources: includes urban areas during disasters
WEMS TOR: CPR may stop after ~30 min without ROSC; do NOT start CPR for obvious death, frozen chest wall, cold water submersion >60 min, or when CPR endangers rescuers
BLS TOR Rule (Verbeek): arrest not witnessed by EMS + no shockable rhythm + no ROSC before transport = **99.5% PPV for death**, 90% specificity for survivors — validated wilderness TOR decision tool
2019 Wilderness Medical Society: recommends **against** rigid cervical collars or rigid backboards in any EMS environment; "spinal motion restriction" (SMR) is the endorsed term
Joint reductions (shoulder, digit, patella) allowed in wilderness scope when evacuation-enabling: only **9 states** permit traditional EMS to perform joint reductions
Epinephrine for anaphylaxis/asthma at all wilderness provider levels; BLS practitioners correctly identify anaphylaxis and use epi correctly **95%** of the time; **epinephrine autoinjectors retain bioavailability after multiple freeze-thaw cycles** — do not discard after cold exposure

⚡PULSE CHECK

QUESTION 1

Wilderness EMS (WEMS) differs from general wilderness medicine because:

A. WEMS uses more advanced medications
B. WEMS is systematic, preplanned, and within the EMS system --- creating increased duty to act and medicolegal expectations
C. WEMS requires federal certification
D. WEMS only applies to mountainous terrain

Answer: B

WEMS = systematic, preplanned delivery of wilderness medicine by formal EMS practitioners within the defined EMS system. This creates increased duty to act and medicolegal expectations vs. opportunistic wilderness medicine by bystanders.

QUESTION 2

Which level of wilderness medical certification requires approximately 60--80 hours of training and allows life-threatening illness/injury management with some medication administration?

A. Wilderness First Aider (WFA)
B. Wilderness First Responder (WFR/WEMR)
C. Wilderness EMT (WEMT)
D. Wilderness Paramedic

Answer: B

WFR/WEMR: 60--80 hours, manages life-threatening illness/injury, some medication administration, some protocol application. WFA: 16--24 hours (basic first aid). WEMT: 120--200 hours (EMT + 48--80 hrs wilderness). Wilderness Paramedic: WFR + EMT-P scope.

QUESTION 3

The wilderness EMS definition includes which environments beyond traditional wilderness settings?

A. Wilderness EMS applies only to mountains, deserts, and caves
B. Wilderness includes any area where geographic challenges alter requirements for or availability of medical/patient movement resources --- including urban areas during disasters
C. Wilderness EMS is limited to areas more than 30 minutes from definitive care
D. Wilderness EMS applies only to environments without cellular coverage

Answer: B

Wilderness = any area where fixed or transient geographic challenges alter requirements for or availability of medical or patient movement resources --- including deserts, mountains, caves, AND urban areas during disasters. The key factor is the altered environment, not just remoteness.

110 Mobile Integrated Health and Community Paramedicine

Definitions

MIH-CP: Provision of health care using patient-centered mobile resources in the out-of-hospital environment (joint vision statement from NAEMSP and other EMS organizations, 2014)
Community paramedic: EMS practitioner with additional training in triage, assessment, and management of chronic disease, mental health, and limited-access populations; coordinates care between patient and health care system
MIH = more about system design; **CP** = specific to enhanced clinician role

Historical Timeline

Alaska: physician extenders for immunizations/chronic disease >100 years
1996: EMS Agenda for the Future called for EMS integration into health care system
2001: Term "community paramedic" first coined
2006: IOM recommended decoupling reimbursement from transport
2014: Joint MIH-CP vision statement adopted by NAEMSP and others
2014 NAEMT survey: 232 active programs
2017 NAEMT survey: 129 programs (decline, but greater maturity and revenue generation)
2019: ET3 (Emergency Triage, Treat, and Transport) program launched by CMMI

Types of MIH-CP Programs

Within 9-1-1:
9-1-1 Triage (nurse triage): low-acuity calls transferred to clinical triage line → alternative sites of care
Alternative Response: Specialized responder type for specific conditions (e.g., behavioral health); only 6.5% of non-transported patients called again within 3 days in one model
Alternative Destination/Disposition: Transport to non-ED destination (e.g., psych facility bypassing ED); 4% redirected to ED in one model with no bad outcomes
EMS Referral: Direct referral to community/social services with or without transport
Unscheduled non-9-1-1:
Clinical Escalation: Requested by primary care, home health, etc., for acute condition changes; >75% kept at home in one model
In-home Urgent Care: NP/EMT or similar team with point-of-care labs, basic imaging, laceration repair, Foley management
Scheduled/Proactive:
Readmission Reduction: Comprehensive care plans for high-risk Medicare patients; one model showed estimated net savings of $2.4 million and ROI of 2.97
Transitions of Care: Post-discharge visits + phone follow-up
Health Maintenance: Wellness/screening visits for vulnerable populations; Canadian model showed significant BP reduction and decreased 9-1-1 calls

Characteristics of Successful MIH Programs

Fully integrated · Collaborative · Supplemental · Data driven · Patient centered · Multidisciplinary · Team based · Educationally appropriate · Consistent with the Triple Aim · **Financially sustainable** · Legally compliant

ET3 (Emergency Triage, Treat, and Transport) Program

5-year voluntary CMS payment model pilot (launched 2019, began 2021)
Allows CMS reimbursement for **treatment in place** (with physician/AP on-scene or via telehealth) and **alternative destinations** (urgent care, primary care, dentist, etc.)
Also allows funding for 9-1-1 medical triage lines
~250 agencies selected; tied to quality reporting

Telemedicine in MIH

Simply adding a physician telephone/video consultation can increase appropriate hospital transport (from 13% to 35% in one model)
Augmented dispatch with telehealth reduced ED transports by >50% in one model
Telemonitoring (weight, glucose, BP) can trigger urgent community paramedic visits

Payment Models to Know

Model	Key Feature
Fee-for-service	Payment per service; incentivizes volume
Traditional EMS payment	Distance × ALS or BLS rate
Accountable Care Organization (ACO)	Shared risk; clinicians profit if costs < payment
Integrated Delivery System (IDS)	Self-contained health ecosystem (e.g., Kaiser)
Bundled payments	Set amount per episode of care
Value-based programs	Reimbursement based on quality

Regulatory Landscape

2018 review: only 16 states had laws specifically pertaining to CP; only 7 had statutes allowing alternative destinations
California and Connecticut: existing language may prohibit CP
Minnesota requires: ≥2 years experience + accredited college-based CP program (~310 hours)
Medical director remains ultimate authority in MIH programs: reduces role confusion

Medical Director Duties in MIH

Perform needs assessment to identify gaps
Guide program goals toward patient care
Coordinate stakeholders and experts
Ensure compliance with state statutes/regulations
Ensure safety and quality
Ensure documentation and reporting
Ensure adequate education for community paramedics and the health care team

PRIORITY PATCH

ET3: launched **2019**, payments began **2021**; CMS pilot allowing reimbursement for treatment in place (with physician/AP or telehealth) and transport to alternative destinations (urgent care, primary care, etc.); ~250 agencies selected — distinguish launch from operational start on exam
Triple Aim: better care for individuals, better health for populations, lower per-capita cost; MIH-CP programs must align with all three
Financial sustainability is the most common limiting factor: many grant-funded programs collapse when funding ends; must build sustainable revenue model from the start
As of 2018: only **16 states** had laws specifically pertaining to CP; only 7 allowed alternative destinations; California and Connecticut existing language may prohibit CP
Medical director remains ultimate authority in MIH programs: reduces role confusion; 7 specific duties defined for MIH medical director oversight
Key MIH outcome metrics: Alternative response: **only 6.5% called back within 3 days**; clinical escalation: **>75% kept at home**; readmission reduction: **ROI 2.97, ~$2.4M estimated net savings** — data for program justification

⚡PULSE CHECK

QUESTION 1

The ET3 (Emergency Triage, Treat, and Transport) program launched in 2019 was created by:

A. NAEMSP
B. CMS through CMMI
C. FEMA
D. NHTSA

Answer: B

ET3 was launched in 2019 by CMMI (Center for Medicare and Medicaid Innovation) to allow EMS to treat in place, transport to alternative destinations, or connect to telehealth --- decoupling EMS reimbursement from transport to the ED. This was catalyzed by the 2006 IOM recommendation to decouple reimbursement from transport.

QUESTION 2

The joint MIH-CP vision statement was adopted by NAEMSP and other organizations in which year?

A. 2001
B. 2006
C. 2014
D. 2019

Answer: C

The joint MIH-CP vision statement was adopted in 2014 by NAEMSP and other EMS organizations. The term 'community paramedic' was first coined in 2001. The 2014 NAEMT survey found 232 active programs; by 2017 it showed 129 programs but with greater maturity and revenue generation.

QUESTION 3

Which MIH/CP program type directly diverts low-acuity 9-1-1 calls to a clinical triage line for alternative site-of-care decisions?

A. Alternative Destination/Disposition
B. 9-1-1 Triage (nurse triage line)
C. Alternative Response (specialized responder)
D. Post-discharge follow-up programs

Answer: B

9-1-1 Triage (nurse triage): low-acuity calls transferred to a clinical triage line → alternative sites of care. Alternative Response: specialized responder (e.g., behavioral health) for specific conditions. Alternative Destination: transport to non-ED destination. Post-discharge: follow-up for high utilizers.

111 Patient Safety Culture

Key Concepts

Adverse event: Unintended and detrimental morbidity or mortality resulting from health care
Near miss: Potential risk of unintended harm that did not result in actual harm: represents an opportunity to improve before harm occurs
Active failure: Unsafe act committed by a person at the point of care
Latent condition: Systemic flaw in design or process that allows hazards to be present
High-reliability organization (HRO): Error-free operations over long periods: goal for EMS organizations; models include nuclear power, commercial aviation, military operations

How Accidents Happen: The Swiss Cheese Model

Multiple protective layers (slices of cheese), each with random holes (failures)
When holes align → trajectory through all layers → adverse event
Holes = active failures (human) + latent conditions (systemic)
Adding more layers (slices) or reducing holes reduces adverse event risk

Human Factors and Ergonomics

Human factors: Traits contributing to adverse events (complacency, fatigue, inattention, eyesight)
Task fixation/tunnel vision: So focused on one task (e.g., intubation, 12-lead ECG) that competing priorities are missed
Ergonomics: Designing work environments to complement human limitations (e.g., color-coded medications, bright orange/blue tourniquets to reduce "left on" errors)
Communication tools:
Callout: Announces action to entire team ("Clear!")
Readback: Receiver repeats message back to sender to confirm accuracy

Behavioral Categories in Patient Safety

Category	Description	Response
Human error	Inadvertent action; slip, lapse, mistake	Console/support
At-risk behavior	Choice increasing unrecognized risk	Coach/educate
Reckless behavior	Conscious disregard of substantial risk	Punitive action

Clinical Decision Making: Dual Process Model

System 1 (intuitive): Fast, pattern-recognition based; developed through experience; can be wrong
System 2 (analytic): Slow, deliberate, resource-intensive; overrides intuitive errors; impaired by stress/fatigue
Physicians make diagnostic errors in 10–15% of cases; likely higher in emergency medicine
Metacognition: "Double-checking" and overriding System 1 when warranted (e.g., STEMI recognition that turns out to be aortic dissection)

Just Culture

Coined by David Marx: shared accountability between organization (responsible for safe system design) and employees (responsible for safe choices)
Replaces "blame and shame" culture with one that encourages reporting and systems-based solutions
Steps to encourage reporting:
Anonymous reporting systems
Easy-to-use reporting tools
"Closed-loop" feedback: reporter receives update on investigation and actions taken
Praise those who come forward

EMS Safety Culture

Safety Attitudes Questionnaire (SAQ) / EMS-SAQ: Most commonly used tool for measuring safety culture
Higher (more positive) safety culture: air medical agencies, private free-standing EMS, smaller organizations (≤50 employees), lower annual patient contact volume
Lower safety culture: urban ground-based models, hospital-based systems, larger organizations (>101 employees), >10,000 annual patient contacts

Measuring Adverse Events in EMS

Triggers for chart review suggesting adverse event:
Incomplete or missing documentation
Time with patient exceeding accepted standards
Patient injury or deterioration
Cardiac arrest during transport
Use of high-risk interventions (intubation, defibrillation, needle thoracostomy)
Documented medication errors
No national adverse event database for EMS currently exists.

Safety Management Systems (SMS)

Must include: written policies/procedures, responsibility/accountability framework, robust recordkeeping, early recognition of hazards, quick intervention, data collection/analysis, audits/investigations, promotion through training and cultural integration

Improving Patient Safety: Methods

Simulation:
Reduces procedural time, cognitive load, and error rates
Can identify latent safety threats in a safe environment
In situ simulation (in the actual clinical environment): identifies latent threats specific to the real work setting; associated with improved technical skills, team performance, reduced adverse events, and reduced mortality
Checklists:
Systematic reviews show improved out-of-hospital intubation success rates with checklists and SOPs
Airway management kit dumps ("shadow template" bags) improve ergonomics and reduce drug/equipment prep errors
General consensus: beneficial and widely accepted in prehospital care

PRIORITY PATCH

Swiss Cheese Model: multiple protective layers, each with holes; adverse event occurs when holes align; add layers or reduce holes to decrease risk
Just Culture (David Marx): shared accountability — organization responsible for safe system design; employees responsible for safe choices; replaces "blame and shame"
Behavioral categories: human error → console; at-risk behavior → coach; **reckless behavior** → punitive action
System 1 (fast, intuitive) vs. **System 2** (slow, deliberate); **stress and fatigue shift decision-making toward System 1** — explains why fatigued EMS providers are more susceptible to premature closure and diagnostic error; metacognition = deliberately overriding System 1
In situ simulation (in actual clinical environment) identifies latent safety threats specific to real work setting; associated with improved outcomes and reduced mortality

⚡PULSE CHECK

QUESTION 1

The Swiss Cheese Model explains how accidents occur by:

A. A single catastrophic failure of one safety layer
B. Alignment of holes in multiple protective layers allowing a trajectory to an adverse event
C. Human error being the primary cause of all adverse events
D. Equipment failure cascading through clinical decision-making

Answer: B

Swiss Cheese Model: multiple protective layers (slices) each with random holes (failures --- both active and latent). When holes align, a trajectory passes through all layers → adverse event. Adding more layers or reducing holes reduces adverse event risk.

QUESTION 2

A 'near miss' in patient safety terminology refers to:

A. An event that caused minor harm to the patient
B. A potential risk of unintended harm that did not result in actual harm --- an improvement opportunity
C. An adverse event reported to OSHA
D. Any deviation from standard protocol regardless of outcome

Answer: B

Near miss = potential risk of unintended harm that did NOT result in actual harm. Represents an opportunity to improve before harm occurs. Adverse event = actual unintended morbidity or mortality from health care.

QUESTION 3

Task fixation/tunnel vision in EMS refers to:

A. Failure to document procedures performed
B. Being so focused on one task (e.g., intubation) that competing priorities are missed
C. Anchoring on the dispatch diagnosis without reassessment
D. Following protocols without clinical thinking

Answer: B

Task fixation/tunnel vision: so focused on one task (intubation, 12-lead ECG) that competing priorities (compressor fatigue, airway dislodgement, scene safety) are missed. This is a human factors issue --- ergonomic design and team callout/readback communication tools help mitigate it.

112 The Evolution of Quality Concepts and Methods

Pioneers of Improvement Science (Manufacturing → Health Care)

Pioneer	Contribution
Walter Shewhart	Statistical process control chart (1924); distinguishes common cause vs. special cause variation; Plan-Do-Study-Act cycle
W. Edwards Deming	Expanded PDSA; "System of Profound Knowledge" (appreciation for a system, knowledge about variation, theory of knowledge, psychology); "14 Points of Management"; revolutionized Japanese manufacturing post-WWII
Joseph Juran	80/20 rule (Pareto Principle): 80% of outcomes from 20% of causes; focus on "vital few" not "trivial many"

Types of Variation

Common cause variation: Inherent in the system ("chance causes"): predictable; address by changing the system
Special cause variation: Due to specific external circumstances ("assignable causes"): unpredictable; address by finding and fixing the specific cause

Health Care Quality History

Milestone	Key Points
Florence Nightingale (1850s)	Used data to show sanitation reduced soldier mortality
Ignaz Semmelweis (19th c.)	Championed handwashing to prevent puerperal fever; not accepted in his lifetime
Flexner Report (1910)	Found 1/3 of US medical schools should close; sparked dramatic reform
Sir William Osler	"Learning science" → M&M conferences, grand rounds, CPC
Ernest Codman (1910)	"End Result System": track patient outcomes; laid groundwork for ACS (1913)
Donabedian (1966)	Framework: **Structure** (settings/personnel/technology) + **Process** (steps of care) + **Outcomes** (end results)
JCAHO (1951)	Joint Commission on Accreditation of Hospitals → now The Joint Commission
To Err Is Human (IOM, 1999/2000)	44,000–98,000 US hospital deaths/year from medical errors; latent systems failures, not individual blame
Crossing the Quality Chasm (IOM, 2001)	Six aims: **Safe, Effective, Patient-centered, Timely, Efficient, Equitable**

Quality Improvement Frameworks

Six Sigma:
Introduced by Motorola (1987); based on Shewhart, Deming, Juran
At 6 sigma: 3.4 defects per 1,000,000 events
DMAIC: **D**efine → **M**easure → **A**nalyze → **I**mprove → **C**ontrol
"Lean" = Six Sigma focus on waste reduction
Model for Improvement:
Developed by Associates in Process Improvement (1996); adopted by IHI
Three questions: What are we trying to accomplish? How will we know a change is an improvement? What change can we make?
Linked to **PDSA cycles** for testing changes on a small scale

Quality Assurance vs. Quality Improvement

	Quality Assurance (QA)	Quality Improvement (QI)
Approach	Reactive	Proactive
Goal	Monitor compliance against a standard	Modify system to produce different results
Focus	Detecting errors after they occur	Preventing errors before they occur

EMS-Specific Quality Milestones

NHTSA 2009: Published 35 consensus-based EMS performance measures
EMS Compass (NHTSA-funded, 2016): Developed 14 performance measures using NEMSIS data elements
NEMSQA (National EMS Quality Alliance, 2018): Took over Compass; published 11 national EMS quality measures
NAEMSP 2018: Position statement "Defining Quality in EMS": 10 key elements
EMS Agenda 2050 (2019): People-centered vision integrating improvement science into all leadership

PRIORITY PATCH

Donabedian (1966): Structure + Process + Outcomes framework; **IOM 2001** six aims: Safe, Effective, Patient-centered, Timely, Efficient, Equitable (**STEEEP + P**)
PDSA = Plan-Do-Study-Act (Shewhart/Deming); start small — most QI failures occur from system-wide implementation without small-scale testing first
Six Sigma: 3.4 defects per million; DMAIC = Define, Measure, Analyze, Improve, Control; "Lean" = waste-reduction focus
NEMSQA (2018): **11** national EMS quality measures (took over from EMS Compass 2016 [14 measures] / NHTSA 2009 [35 measures]); progression 35 → 14 → 11 reflects increasing consensus; 11 is the current exam-tested standard
Common cause variation = inherent in system (change the system); special cause variation = external specific cause (find and fix the specific cause)

PULSE CHECK

QUESTION 1

Walter Shewhart's primary contribution to quality improvement science was:

A. The 80/20 rule (Pareto Principle)
B. Statistical process control charts distinguishing common cause from special cause variation, and the PDSA cycle
C. The 'System of Profound Knowledge' and 14 Points of Management
D. The Donabedian Structure-Process-Outcome framework

Answer: B

Shewhart (1924): statistical process control charts, distinguishes common cause vs. special cause variation, and originated the Plan-Do-Study-Act (PDSA) cycle. Deming expanded PDSA and developed the 14 Points. Juran developed the 80/20 (Pareto) Principle.

QUESTION 2

The Donabedian quality framework organizes health care quality into which three dimensions?

A. Safety, efficacy, and efficiency
B. Structure (settings/personnel/technology), Process (steps of care), and Outcomes
C. Prevention, treatment, and rehabilitation
D. Clinical, operational, and financial quality

Answer: B

Donabedian (1966) framework: Structure (settings, personnel, technology), Process (steps of care), and Outcomes (results of care). This is the foundational framework for health care quality measurement and improvement.

QUESTION 3

Common cause variation differs from special cause variation in that:

A. Common cause is unpredictable and requires finding the specific cause
B. Common cause is inherent in the system, predictable; address by changing the system
C. Special cause is inherent and requires system redesign
D. They are interchangeable terms for random variation

Answer: B

Common cause variation: inherent in the system ('chance causes'), predictable --- address by changing the system. Special cause variation: specific external circumstances ('assignable causes'), unpredictable --- find and fix the specific cause. This distinction drives different QI approaches.

113 Defining, Measuring, and Improving Quality

Deming's System of Profound Knowledge (4 Lenses)

Appreciation for a system: View problems as systemic, not individual; long-term focus
Knowledge of variation: Common cause vs. special cause variation; stable systems have predictable variation
Theory of knowledge: Prediction, learning, experimentation; basis for PDSA method; guard against confirmation bias
Psychology: People inherently want to do a good job; frontline workers are the source of solutions, not problems

Model for Improvement: Three Elements

Aim (What are we trying to accomplish?): specific, time-bound, patient-centered; addresses What? By when? For whom?
Measurement (How will we know a change is an improvement?): specific, numerical, data-driven
Change (What changes will result in improvement?): informed by literature, experts, and frontline personnel; organized via root cause analysis tools
Strong vs. Weak Aim Statement Examples:
Improvement Science: Strong vs. Weak Evidence

Strong	Weak
"Document blood glucose in 95% of stroke alert patients in 180 days"	"Improve first pass intubation rates"
"Compression rates 100–120/min in ≥85% of adult cardiac arrests by Jan 1"	"Increase cardiac arrest survival by 25% over the next year"

PDSA Cycle (Plan-Do-Study-Act)

Plan: Identify objective, predict outcomes, choose what to test
Do: Execute on small scale (single crew, station, battalion): small-scale testing is critical
Study: Analyze results vs. prediction; what was learned?
Act: Adopt, adapt, or abandon the change based on what was learned
Key principle: Start small. Most QI failures occur from system-wide implementation without small-scale testing.

Root Cause Analysis Tools

Fishbone (Ishikawa) Diagram:
Cause-and-effect diagram
"Head" = the problem; "bones" = categories of causes
Common branches: Methods, Equipment, People, Materials, Measurement, Environment
Driver Diagram:
Organizes solutions to problems identified by fishbone
Shows relationship between primary drivers and secondary drivers leading to the aim

Data Display Tools

Tool	Use
Run chart	Process performance over time; identifies trends
Control chart	Run chart + control limits (SD lines); distinguishes common cause from special cause variation
Pareto chart	Bar chart showing frequency of causes in descending order; identifies "vital few"

Data Sources for QI

Direct observation: Most accurate; resource-intensive
Chart review: Most common; limited by documentation quality and retrospective nature
Hospital outcomes: Critical for meaningful measures; requires data sharing agreements
Patient feedback: Underutilized; provides patient-centered perspective
Combination of all sources = most comprehensive and effective QI program

Shifting Focus in EMS Quality

Historical focus: **operational measures** (response times): easy to capture but not patient-centered
Emerging focus: **clinical outcomes** (cardiac arrest survival, stroke outcomes, STEMI time-to-balloon)
Evidence-based process measures (e.g., time to ECG, time first medical contact to balloon for STEMI) are valuable when linked to

outcomes

NAEMSP 2018 "Defining Quality in EMS": 10 Elements

Prioritize patient outcomes
Dynamic and continuous QI efforts
Evidence-based practice in all EMS domains
Adequate infrastructure for quality at local levels
Seamless, large-scale bidirectional data sharing
EHRs that support QI monitoring and reporting
Uniform quality terminology and definitions
Partnership between operational and medical communities (system-based, safety-focused)
QI training for dedicated personnel
Promote a culture of safety

PRIORITY PATCH

Failure to honor even **one** of Deming's four lenses (system, variation, knowledge, psychology) will likely cause a QI project to fail
Strong aim statement: specific (who, what, how much), time-bound, patient-centered; "Improve intubation rates" is a weak aim; "≥85% compression rate 100-120/min by Jan 1" is strong
Fishbone (Ishikawa) = identifies causes; **Driver diagram** = organizes solutions; **Control chart** = monitors whether solution is working — these form a **sequential QI workflow**, not interchangeable tools: Fishbone → Driver Diagram → Control Chart
Data source hierarchy: direct observation (most accurate) > chart review (most common) > hospital outcomes (critical but requires sharing agreements) > patient feedback (underutilized)
Historical EMS focus: operational measures (response times); emerging focus: **clinical outcomes** (cardiac arrest survival, stroke outcomes, STEMI time-to-balloon)

⚡PULSE CHECK

QUESTION 1

A well-written EMS quality improvement aim statement should be:

A. Broad and aspirational to allow flexibility
B. Specific, time-bound, and patient-centered --- addressing what, by when, and for whom
C. Focused on process metrics rather than outcomes
D. Written by administration without frontline provider input

Answer: B

Strong aim statement: specific, time-bound, patient-centered (e.g., 'Document blood glucose in 95% of stroke alert patients within 180 days'). Weak: 'Improve first pass intubation rates.' PDSA requires a specific aim before small-scale testing.

QUESTION 2

In PDSA cycle methodology, the 'Do' step should be performed:

A. System-wide simultaneously to maximize impact
B. On a small scale first (single crew, station) to test before broader implementation
C. In parallel with multiple different interventions
D. Only after all stakeholders have approved the change

Answer: B

PDSA 'Do' = execute on SMALL scale (single crew, station, battalion). Small-scale testing is critical --- it allows learning from failures before system-wide implementation. The cycle then repeats to adopt, adapt, or abandon based on results.

QUESTION 3

Deming's 'psychology' lens in his System of Profound Knowledge holds that:

A. Individual motivation is primarily financial
B. People inherently want to do a good job; frontline workers are the source of solutions, not problems
C. Punishing poor performance drives improvement
D. Management should not be influenced by frontline worker opinions

Answer: B

Deming's psychology lens: people inherently want to do a good job; frontline workers are the source of solutions, not problems. QI efforts should engage frontline providers rather than impose top-down mandates. This contrasts with punitive approaches to quality issues.

114 Information Systems

Historical Foundations

1973 EMS Systems Act: defined 15 EMS components (information system not yet one)
1994 NHTSA Uniform Prehospital Dataset: 81 data elements; first standardized definitions
1996 NHTSA EMS Agenda for the Future: information systems as one of 14 recommended attributes, with 5 recommendations:
Adopt uniform data elements/definitions
Develop valid, reliable, accurate data transmission mechanisms
Describe the entire EMS event for outcomes and cost-effectiveness analysis
Collaborate to develop integrated information systems
Provide feedback to data generators (research, QI, evaluation)
1998: EMS Agenda for the Future Implementation Guide: information system as "backbone" of EMS

NEMSIS (National EMS Information System)

Formally funded 2001 by NHTSA based on 1999 HRSA/EMSC feasibility study
Four primary goals:
Standardized national EMS dataset for every EMS event
Electronic EMS documentation in every local EMS system
State EMS database in every state
National EMS database aggregating state data
NEMSIS Version 3.5: >500 structured data elements; in use by all 56 states and territories
2019 data: 10,062 EMS agencies; 37,047,990 activations; 24,249,664 patients treated/transported; represents 43% of agencies but 80% of national activations
65% of activations result in patient treatment or transport
NEMSIS incorporated into: **Health Level 7 (HL7)** standards and **ICD-10** coding

IOM 2006 "Emergency Medical Services at the Crossroads"

Recommendations regarding EMS information systems:
Evidence-based categorization for EMS, EDs, and trauma centers
Evidence-based model prehospital protocols
Evidence-based performance indicators
Integrated, interoperable hospital/EMS/public safety/emergency management data systems
Increased federal funding targeting EMS systems and outcomes research

ET3 and Data Requirements

ET3 (2019 CMS program): 5-year pilot allowing alternative destinations and treatment in place
Participating agencies have data reporting requirements
Bipartisan Budget Act of 2018: required HHS to develop a data collection system for EMS cost, revenue, and utilization for Medicare/Medicaid providers

EMS Information System Components

Dataset: 5 Categories:
Situational: location, response info, access
Patient: demographics, billing, medical history
Surveillance: injury mechanism, cardiac arrest, review of systems
Diagnostic/physiological: vital signs, physical exam
Interventional: procedures, treatment, disposition
Hardware:
Moved from dedicated server rooms to mobile devices and cloud-based platforms
Cloud platforms (Amazon, Google, Microsoft): security, access management, device management; lower initial cost via subscription model
Software: 4 Components:
Front-end user interface: Data entry and viewing; should guide workflow based on patient condition
Database: Storage, retrieval, external data import, record linkage
Exchange/linkage engine: Sends/receives data to/from other health systems (EMS → hospital → outcome data back to EMS)
Back-end analytics: Report generation, data analysis, operational/clinical/billing analytics
Emerging software: Automated machine learning, artificial intelligence, clinical decision support: real-time recommendations based on

patient condition and evidence-based protocols

HIPAA Security Requirements for EMS Information Systems

Patient privacy and confidentiality
User policy and procedure (who/when/where/how/why can access the system)
Physical security (locked files, controlled access, entry logs)
Software security (user authentication, data encryption)
Note: EU General Data Protection Regulation (GDPR) is more stringent and adds the right to delete one's own record.

Key Existing Registries

Registry	Organization	Focus
NEMSIS	NHTSA/states	All EMS events
CARES (Cardiac Arrest Registry to Enhance Survival)	Emory University (CDC-funded initially)	OHCA; 28 statewide registries; 1,800+ EMS systems
National Trauma Data Bank (NTDB)	ACS Committee on Trauma	Trauma; incorporates NEMSIS elements
Paul Coverdell National Acute Stroke Registry	CDC	Stroke; active in 9 states
CODES (Crash Outcome Data Evaluation System)	NHTSA (1992)	Motor vehicle crashes; medical/financial outcomes; 15 states

Data Use at Each Level

Level	Primary Uses
Local	Resource allocation, service delivery, personnel performance, patient care
State	Resource allocation, legislative initiatives, coverage assurance, educational programs, performance improvement
National	Policy, advocacy, educational curricula, reimbursement

EMS Agenda 2050 Vision for Information Systems

Devices and software become "true members of the health care team"
Real-time clinical decision support based on evidence-based guidelines
Automated adverse event review on arrival to ED
Patient outcome data automatically available for QI feedback
EMS no longer isolated as "transportation": integrated with health care system
Currency shifts from response intervals and transport to clinical care, outcomes, and cost/value

PRIORITY PATCH

NEMSIS v3.5: >500 data elements; all 56 states/territories; 2019 data: 37 million activations from 10,062 agencies; 65% result in treatment or transport — **35% do not**; this is the data foundation for MIH/CP and 9-1-1 nurse triage programs
CARES: Emory/CDC, cardiac arrest registry; **NTDB**: ACS trauma; **Coverdell**: CDC stroke (9 states); **CODES**: NHTSA 1992, motor vehicle crash outcomes
HIPAA security: patient privacy, user policy, physical security, software security (authentication + encryption); EU GDPR adds right to delete one's own record
EMS information system software: front-end interface → database → exchange/linkage engine → **back-end analytics**; emerging: AI/ML clinical decision support
IOM 2006 Crossroads recommendations: evidence-based categorization, model protocols, performance indicators, **integrated interoperable data systems** (most tested — bidirectional EMS↔hospital data flow; addresses the data silo problem), federal funding increase

⚡PULSE CHECK

QUESTION 1

NEMSIS (National EMS Information System) was formally funded in which year?

A. 1994
B. 1998
C. 2001
D. 2006

Answer: C

NEMSIS was formally funded in 2001 by NHTSA based on a 1999 HRSA/EMSC feasibility study. NEMSIS Version 3.5 has >500 structured data elements and is used by all 56 states and territories. 2019 data: 10,062 EMS agencies, 37 million activations.

QUESTION 2

The 1994 NHTSA Uniform Prehospital Dataset contained how many data elements and was significant for which reason?

A. 250 elements --- first electronic EMS documentation system
B. 81 elements --- first standardized prehospital data definitions
C. 500 elements --- first national EMS database
D. 30 elements --- first state EMS reporting requirement

Answer: B

The 1994 NHTSA Uniform Prehospital Dataset: 81 data elements and was the first standardized prehospital dataset with uniform definitions. NEMSIS (2001) expanded this into a fully structured electronic national system.

QUESTION 3

Which of the following is NOT an information systems recommendation from the 1996 NHTSA EMS Agenda for the Future?

A. Describe the entire EMS event for outcomes and cost-effectiveness analysis
B. Collaborate to develop integrated information systems
C. Provide feedback to data generators (research, QI, evaluation)
D. Systems should develop individual data elements/definitions

Answer: D

The 5 recommendations are: adopt uniform data elements/definitions; develop valid, reliable, accurate data transmission mechanisms; describe the entire EMS event for outcomes and cost-effectiveness analysis; collaborate to develop integrated information systems; provide feedback to data generators (research, QI, evaluation).

115 EMS Research Basics

Why Research Matters

Primary purpose: improve patient care
Indirect benefits: investigator expertise, specialty recognition, improved teamwork
Classic EMS research challenge: often driven by non-experimental approaches, surrogate settings, or systems research (complex, multi-agency, poorly controlled environments)

Getting Started: The PICO Framework

PICO = Patient/Population · Intervention · Comparison/Control · Outcome(s)
Every research question should pass the **"So what?" test**: clear, focused, and important
Write the hypothesis/objective *before* looking at data
Avoid **data mining** (searching for a question in an existing data set without a prior hypothesis: leads to spurious findings)
Literature review databases: **MEDLINE** and **CINAHL** (Cumulative Index to Nursing and Allied Health)

Study Design: Three Key Questions

#	Question	Options
1	Follow participants over time?	Cross-sectional vs. Longitudinal
2	Intervene with participants?	Observational vs. Interventional
3	Events occurred already or as they happen?	Retrospective vs. Prospective

Study Designs: Descriptive (Lowest Rigor)

Design	Key Feature	Limitation
Correlational (aggregate/ecologic)	Compares rates in populations	Ecological fallacy: cannot assume individual-level causation
Case Report	1 patient; detailed description	Not generalizable; hypothesis only
Case Series	Multiple patients; same phenomenon	No controls; hypothesis only
Cross-Sectional Survey (prevalence study)	Snapshot; exposure + outcome measured simultaneously	Cannot establish cause-effect; measures prevalence, not incidence

Study Designs: Analytical: Observational

Case–Control Study
Patients identified by **outcome** (cases vs. controls), then look back at exposure
Usually retrospective
✅ Best for **rare outcome / common exposure**; efficient; can study multiple exposures
❌ Hard to establish temporal sequence; recall bias; sampling bias; hard to identify controls
Cohort Study
Patients identified by **exposure status**, followed forward toward outcome
Can be prospective or retrospective
✅ Best for **rare exposure / common outcome**; temporal sequence established; limits measurement bias
❌ Expensive (long follow-up); loss to follow-up risk; bad for rare outcomes
Before–After Study
Data collected before and after a system change
Purely observational if researchers didn't implement the change
Quasi-experimental if researchers implemented the change then studied it
Example: OPALS study (before–after design across multiple phases)

Study Designs: Experimental (Highest Rigor)

Randomized Controlled Trial (RCT)
Participants randomly assigned to treatment arms
Gold standard for establishing causality
Must have **clinical equipoise** (no clear prior benefit/harm known)
Blinding:
Single-blind: subjects don't know treatment assignment

Double-blind: subjects AND outcome assessors don't know
Triple-blind: subjects, assessors, AND treating clinicians are blinded
Pseudo-randomization (e.g., alternate days, SSN digits): simplifies logistics but may introduce bias
Crossover trial: each participant serves as own control; requires washout period
Newer Designs
Platform trial: studies multiple domains (questions) in the same patient population simultaneously; interventions can be added/dropped as evidence accumulates
Adaptive trial design: uses interim data + statistical modeling to modify or stop enrollment in arms unlikely to succeed; more efficient than fixed sample-size trials

Bias Glossary

Term	Definition
Sampling bias	Cases identified from a single source; may miss cases not presenting there
Measurement bias	Disease status influences retrospective recall of exposure
Recall bias	Sick patients (cases) recall exposures more than controls
Assessment bias	Investigator's prior beliefs influence outcome judgment
Washout period	Delay after implementation before data collection begins; allows full adoption of new therapy
Ecological fallacy	Assuming group-level data applies to individuals
Confounding	Third variable distorts apparent relationship between exposure and outcome

PRIORITY PATCH

Study design power hierarchy: Case report/series < Cross-sectional < Case-control < Cohort < **RCT**; longitudinal + interventional + prospective = greatest causal power
Case-control = identified by **C**onsequence (outcome) → look back; best for rare outcomes. **Cohort** = identified by **C**ause (exposure) → follow forward; best for rare exposures
RCT requirements: **clinical equipoise** (no clear prior benefit known; if one arm becomes clearly beneficial during the trial, equipoise is lost → **Data Safety Monitoring Board (DSMB) triggers early stopping**); blinding types: single (subjects), double (subjects + assessors), triple (+ treating clinicians)
Platform trial: multiple questions, same population, interventions can be added/dropped. **Adaptive trial**: uses interim data to modify enrollment — more efficient than fixed-sample designs
Data mining = searching data without prior hypothesis → spurious findings; every research question must pass the "So what?" test: clear, focused, and important
Classic EMS confounders: ALS/BLS comparisons (sicker patients get ALS → ALS appears worse); urban/rural (shorter transport times confound outcomes); registry case-mix differences between systems

⚡PULSE CHECK

QUESTION 1

The PICO framework for research questions stands for:

A. Problem, Intervention, Comparison, Outcome
B. Population/Patient, Intervention, Comparison/Control, Outcome(s)
C. Purpose, Inclusion, Criteria, Objectives
D. Patient, Indication, Contraindication, Observation

Answer: B

PICO = Patient/Population, Intervention, Comparison/Control, Outcome(s). Every EMS research question should pass the 'So what?' test: clear, focused, and important. Write the hypothesis before looking at data to avoid data mining.

QUESTION 2

Which study design has the highest level of evidence in the hierarchy?

A. Case series
B. Cross-sectional survey
C. Prospective RCT (double-blinded)
D. Retrospective cohort

Answer: C

Study design hierarchy (descending rigor): Prospective RCT (double-blind) → prospective/retrospective observational/cohort → retrospective/database/case-control → case series/reports. RCTs can be conducted in EMS using EFIC when consent is not feasible.

QUESTION 3

Data mining (searching for a question in an existing data set without a prior hypothesis) is problematic because:

A. It is too time-consuming for busy EMS researchers
B. It leads to spurious findings from multiple comparisons without pre-specified hypotheses
C. It requires IRB approval that is difficult to obtain
D. It produces results that are not publishable

Answer: B

Data mining --- searching for a question in existing data without a prior hypothesis --- leads to spurious findings. With enough variables, random associations will appear significant by chance. Always write the hypothesis/objective before looking at data.

116 Informed Consent for EMS Research

Historical Timeline

Year	Event
1964	Declaration of Helsinki: first international ethics standard for medical research
1974	National Research Act: first U.S. public bioethics policy; response to **Tuskegee syphilis study**
1979	**Belmont Report**: defined three core principles; established IRBs
1991	**Common Rule**: harmonized all federal human subjects regulations (45 CFR Part 46, Subpart A)
1993	Presidential investigation → FDA halted all resuscitation research for ~4 years
1996	**Final Rule / 21 CFR 50.24**: created EFIC mechanism; FDA re-authorized emergency research
2018–2019	**Revised Common Rule** took full effect (updated for biospecimens, electronic records, single IRB for cooperative studies)

Belmont Report: Three Core Principles

Principle	Application
Respect for Persons	Free, voluntary, informed consent; special protections for vulnerable populations
Beneficence	Minimize risks, maximize benefits; "do no harm"
Justice	Risks AND benefits distributed fairly across populations

The Common Rule & IRB

IRB = Institutional Review Board: primary mechanism for ensuring ethical conduct
Every study involving human subjects or their data must be reviewed by an IRB
IRB determines: Is this research? Can it be reviewed via expedited process? Can consent/documentation be waived?
Many journals require IRB documentation before publication
Non-academic EMS researchers should affiliate with an academic investigator who can navigate IRB processes

EFIC vs. Waiver of Informed Consent (WIC)

Feature	EFIC (21 CFR 50.24)	WIC (45 CFR 46.116)
Framework	FDA	HHS
Used when	Life-threatening emergency; consent not feasible	Low-risk research; consent impracticable
Drug/device studies	Requires IND or IDE	Not required
Community consultation	Required	Required
Public disclosure	Required (pre and post)	Required

EFIC Conditions (all must be met):
Life-threatening situation exists
Available treatments unproven or unsatisfactory
Valid scientific evidence needed to determine safety/efficacy
Consent not feasible (patient's medical condition)
Treatment must begin before representative can be reached
No way to prospectively identify likely subjects
Risks/benefits are reasonable
Participation holds prospect of direct benefit
Research cannot practicably proceed without the waiver — **EFIC is a last resort, not a convenience**; this ninth condition reinforces that EFIC cannot be used simply because consent is inconvenient

Community Consultation: bidirectional discourse with community stakeholders prior to enrollment; provides opportunity for input, opt-out mechanism, and transparency
Public Disclosure: one-way information transfer:
Pre-study: intent, protocol, risks, benefits, consent plan
Post-study: demographics of participants and study results

PRIORITY PATCH

Research ethics timeline: **1964** Helsinki → **1974** National Research Act (post-Tuskegee) → **1979** Belmont Report → **1991** Common Rule → **1993** FDA halted resuscitation research → **1996** EFIC created
EFIC ≠ WIC: EFIC (21 CFR 50.24) is FDA, for higher-risk emergency research requiring IND/IDE; WIC (45 CFR 46.116) is HHS/IRB, for lower-risk research
FDA is NOT a Common Rule agency: drug/device studies under EFIC require additional FDA steps (IND or IDE)
Community consultation = bidirectional (town halls, input, opt-out mechanism); **public disclosure** = one-way (pre-study intent + post-study results)
Belmont Report three principles: **Respect for Persons** (voluntary informed consent), **Beneficence** (minimize risk, maximize benefit), **Justice** (fair distribution of **both risks AND benefits** across populations — *common exam trap: defining Justice as risk-only*)

PULSE CHECK

QUESTION 1

The three core principles of the Belmont Report (1979) are:

A. Beneficence, Non-maleficence, and Autonomy
B. Respect for Persons, Beneficence, and Justice
C. Autonomy, Beneficence, and Non-maleficence
D. Justice, Veracity, and Fidelity

Answer: B

Belmont Report: Respect for Persons (free, voluntary, informed consent; protections for vulnerable populations), Beneficence (minimize risks, maximize benefits), and Justice (risks and benefits distributed fairly across populations).

QUESTION 2

The EFIC (Exception from Informed Consent) mechanism under 21 CFR 50.24 was established in which year?

A. 1974
B. 1991
C. 1996
D. 2001

Answer: C

The 1996 Final Rule / 21 CFR 50.24 created EFIC, re-authorizing emergency research after FDA halted all resuscitation research for approximately 4 years (1993) following a Presidential investigation. EFIC allows research in emergency conditions when consent is not feasible.

QUESTION 3

During which year was the Belmont Report issued?

A. 1964 --- Declaration of Helsinki
B. 1974 --- National Research Act in response to the Tuskegee syphilis study
C. 1979 --- response to thalidomide birth defects
D. 1991 --- Common Rule implementation

Answer: B

The Belmont Report was issued in 1979. The National Research Act of 1974 (first U.S. public bioethics policy, prompted by the Tuskegee syphilis study) created the commission that produced the Belmont Report. This established IRBs as the primary oversight mechanism.

117 Out-of-Hospital Cardiac Arrest Research

Epidemiology Context

~111 nontraumatic OHCA per 100,000/year assessed by EMS in North America
~74 per 100,000 have resuscitation attempted
U.S. overall survival to discharge: ~10.4% (range 7.8–15% by state)
International overall survival: ~9.7% (range 3.1–22% across registries)

Chain of Survival as Research Framework

5 links (added in 2010): (1) immediate recognition/activation, (2) early CPR, (3) rapid defibrillation, (4) effective ALS, (5) integrated post-arrest care
Research may focus on individual links OR "bundles" affecting multiple links

Study Design Considerations for OHCA

RCTs

Have enrolled large numbers successfully in OHCA
Facilitated by: EFIC, simple enrollment procedures, no research assistants needed during resuscitation
Most OHCA RCTs have NOT shown differences between treatment groups
Key limitation: generalizability (different EMS systems, communities, in-hospital management)

Observational Studies

Rely on large population-based registries and post-hoc analysis of trial datasets
Limited to associations; cannot establish causation
Before-after/time-series may infer change after intervention but limited by temporal confounders
Case-control: infrequently used (large registries available), but useful for rare presentations (e.g., toxicological arrest)

Utstein Style

Gold standard reporting framework for OHCA: first introduced 1991, updated 2004 and 2015
Allows comparison of outcomes across systems and countries
Accounts for ~50% of variation in outcomes
Denominators: EMS-treated cases AND EMS-assessed cases
Regional variation in reported incidence may reflect: actual differences, societal norms, resuscitation practice, data-collection techniques

Key OHCA Outcomes

Outcome	Notes
ROSC	Necessary first step; may not correlate with meaningful survival
Survival to hospital admission	Isolates OOH phase; less patient-centered
Survival to hospital discharge (or 30-day survival)	Most common endpoint; easy to ascertain
Neurological outcome at discharge	CPC scale (see below) or modified Rankin Scale; resource-intensive
Quality of life at 90 days / 1 year	Most patient-centered; difficult to collect

Cerebral Performance Category (CPC) Scale:

CPC	Description
1	Good: alert, able to work, normal life (minor deficits ok)
2	Moderate disability: can do ADLs independently or part-time sheltered work
3	Severe disability: conscious but dependent on others
4	Comatose / vegetative state
5	Death / brain death

Utstein Adjustment Covariates (Standard for OHCA Logistic Regression)

Age
Sex
Public vs. private location

Witnessed status (bystander, EMS, or none)
Bystander CPR
Initial cardiac rhythm (shockable vs. non-shockable)
9-1-1 call-to-EMS-arrival interval

Data Monitoring

Data and Safety Monitoring Board (DSMB): required for interventional trials; reviews accumulated data periodically; can stop trial early for benefit, harm, or futility

Reporting Standards

Acronym	Full Name	Applies To
CONSORT	Consolidated Standards of Reporting Trials	RCTs
STROBE	Strengthening the Reporting of Observational Studies in Epidemiology	Observational studies
MOOSE	Meta-Analysis of Observational Studies in Epidemiology	Meta-analyses of observational studies
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses	Systematic reviews/meta-analyses

PRIORITY PATCH

U.S. OHCA survival to discharge: ~**10.4%** (range 7.8–15% by state); international: ~9.7% (range 3.1–22%)
DSMB three stopping rules: (1) **benefit** — one arm clearly better; (2) **harm** — one arm clearly worse; (3) **futility** — continued enrollment unlikely to show a difference; futility is the most commonly missed stopping criterion
ILCOR COSCA recommended outcomes: survival to discharge + modified Rankin at discharge; HRQoL (Health Utility Index 3, SF-36, EQ5D-5L) at 90 days and up to 1 year
Utstein Style (1991, updated 2015): standardized OHCA reporting; accounts for ~50% of outcome variation; **two denominators: EMS-assessed** (broader, includes all assessed) vs. **EMS-treated** (narrower, resuscitation attempted) — using different denominators explains some apparent international survival variation
Reporting standards: **CONSORT** (RCTs), **STROBE** (observational), **PRISMA** (systematic reviews), **MOOSE** (meta-analyses of observational studies)
OHCA RCT challenge: most have NOT shown treatment differences; primary limitation = generalizability across different EMS systems, communities, and in-hospital management
CPC 1–2 = favorable neurological outcome (standard OHCA trial threshold); CPC 3–4 = unfavorable; modified Rankin Scale (mRS) increasingly used as alternative outcome measure

⚡PULSE CHECK

QUESTION 1

The Utstein Style framework for OHCA research was first introduced in which year?

A. 1980
B. 1991
C. 2001
D. 2010

Answer: B

Utstein Style was first introduced in 1991, with updates in 2004 and 2015. It is the gold standard reporting framework for OHCA, enabling comparison of outcomes across systems and countries by standardizing definitions and data elements.

QUESTION 2

U.S. overall survival to hospital discharge from OHCA is approximately:

A. 3--5%
B. 10.4% (range 7.8--15% by state)
C. 20--25%
D. 30--35%

Answer: B

U.S. OHCA overall survival to discharge: approximately 10.4% (range 7.8--15% by state). International range: approximately 9.7% (range 3.1--22% across registries). Approximately 74 per 100,000 North Americans have resuscitation attempted annually.

QUESTION 3

A key limitation of most prehospital RCTs in OHCA is:

A. Too few patients enrolled to be statistically significant
B. Difficulty obtaining IRB approval for emergency research
C. Generalizability --- results may differ across EMS systems, communities, and in-hospital management
D. EFIC cannot legally be used for cardiac arrest research

Answer: C

Most OHCA RCTs have NOT shown differences between treatment groups. Key limitation: generalizability --- different EMS systems, communities, and in-hospital management make results difficult to extrapolate. RCTs are feasible in OHCA using EFIC with simple enrollment procedures.

118 Trauma Research Methodology

Background

Trauma = ~13.4% of EMS calls (per NEMSIS, 2019)
Trauma is #1 cause of death in Americans ages 1–44; #3 overall
~170,000 deaths from unintentional injuries in 2017

Study Designs (Descending Rigor)

Prospective RCT (double-, single-, or unblinded)
Prospective/retrospective observational/cohort
Retrospective/database analysis/case-control
Case series/case reports

Key Design Issues in Prehospital Trauma Research

Informed Consent

EFIC (21 CFR 50.24) allows exception when consent not feasible in emergency
First used in the DCLHb (diaspirin cross-linked hemoglobin) traumatic shock trial
Patients may withdraw after stabilization; virtually all continue participation
Scripts, algorithms, and opt-out plans simplify EFIC implementation

Inclusion/Exclusion Criteria

Blunt vs. penetrating: often separate trials needed (different outcomes)
Define "shock" explicitly (e.g., sBP <90 mmHg)
Consider excluding traumatic arrests and GCS <5 (non-survivable; masks effect of intervention)
Typical age range in prehospital trauma trials: 18–65 years (pediatric/geriatric studied separately)
Clinical equipoise must exist to justify EFIC use

Randomization in Trauma RCTs

Sealed envelopes or medical oversight phone assignment preferred over alternating days (reduces bias)
After randomization: **intention-to-treat (ITT) analysis**: all patients analyzed in their assigned group regardless of whether they actually received the treatment

Blinding

Medications easier to blind than procedures
Pre-packaged identical-appearing intranasal agents are one approach

Outcome Measures for Trauma Research

Survival (30-day, to ED, to OR, to ICU): simple, non-biased
Cerebral Performance Category (CPC): TBI/stroke outcomes
TRISS (Trauma Score–Injury Severity Score): predicts expected survival for comparison; includes age
Revised Trauma Score (RTS): calculated from GCS + vital signs; available in field
Injury Severity Score (ISS): anatomical score; top 3 AIS scores squared and summed; cannot be calculated in field or ED
Patient-Reported Outcome Measures (PROMs): questionnaires; increasingly emphasized

Key Data Sources

Database	Description
NEMSIS	National EMS Information System; broadest national view of EMS data
State Trauma Registries	Hospital-based; required reporting in many states
JTTR (Joint Theater Trauma Registry)	Military; Iraq/Afghanistan casualties; led to expanded tourniquet use and restricted Factor VIIa

Trauma Scoring Reference

Score	Calculated When?	Based On
RTS (Revised Trauma Score)	Field/ED	GCS, sBP, RR
ISS (Injury Severity Score)	Hospital (requires AIS)	Top 3 AIS scores by body region
TRISS	Hospital	RTS + ISS + age

Military Trauma Research Contributions (JTTR Examples)

Tourniquets: documented dramatic decrease in mortality from extremity hemorrhage → adopted widely by civilian EMS
Factor VIIa: initial promise for traumatic hemorrhage; JTTR revealed increased thromboembolic events during long transport → use restricted

PRIORITY PATCH

ISS: anatomical, cannot calculate in field/ED (requires full AIS survey); **RTS**: GCS + sBP + RR, can calculate in field; **TRISS** = RTS + ISS + age, hospital only
EFIC first used in the DCLHb (diaspirin cross-linked hemoglobin) prehospital traumatic shock trial; ITT analysis: all patients analyzed in assigned group regardless of actual treatment received
JTTR outcomes: widespread tourniquet adoption for extremity hemorrhage; Factor VIIa restricted after JTTR revealed increased thromboembolic events during long transport
Trauma RCT design: define shock explicitly (e.g., sBP <90); exclude traumatic arrests and GCS <5 (**methodological, not purely ethical** — unsurvivable injury dilutes treatment effect even if intervention is effective); blunt vs. penetrating often require separate trials
Trauma = ~**13.4%** of EMS calls (NEMSIS 2019); #1 cause of death ages 1–44; ~170,000 unintentional injury deaths in 2017

PULSE CHECK

QUESTION 1

In prehospital trauma RCTs, which randomization method is preferred over alternating days to reduce selection bias?

A. Patient birthdate (odd/even)
B. Sealed envelopes or medical oversight phone assignment
C. Block randomization by shift
D. Cluster randomization by geographic region

Answer: B

Sealed envelopes or medical oversight phone assignment are preferred over alternating days (easily predicted and gamed). After randomization, intention-to-treat (ITT) analysis is used --- all patients analyzed in their assigned group regardless of whether they actually received the treatment.

QUESTION 2

Intention-to-treat (ITT) analysis in trauma RCTs means:

A. Only patients who completed the full protocol are analyzed
B. All patients are analyzed in their assigned group regardless of protocol adherence
C. Patients who crossed over are excluded from analysis
D. Only surviving patients are included in outcome analysis

Answer: B

ITT analysis: all patients analyzed in their assigned group regardless of whether they actually received the treatment. This preserves randomization and prevents bias from non-random crossover, maintaining the integrity of the RCT.

QUESTION 3

Why is GCS <5 often excluded from prehospital trauma research trials?

A. Accurate GCS assessment is not possible prehospitally
B. GCS <5 represents likely non-survivable injury that would mask the treatment effect
C. EFIC cannot be applied to patients with GCS <5
D. Family consent is impossible to obtain for GCS <5 patients

Answer: B

GCS <5 and traumatic arrests are often excluded because they represent likely non-survivable injuries --- including them would dilute or mask the treatment effect of interventions targeted at salvageable patients. Typical prehospital trauma trial age range: 18--65 years.

119 Pediatric Research Methodology

Background

Children = ~10% of EMS encounters; ~2 million prehospital pediatric encounters/year
Only 10–20% of those have critical complaints
Pediatric EMS is NOT a recognized medical subspecialty (unlike pediatric emergency medicine, recognized ~3 decades ago)
IOM 2006 report: *Emergency Care for Children: Growing Pains*: characterized pediatric emergency care as a multifaceted crisis

Key Pediatric Research Networks

Network	Description
PECARN (Pediatric Emergency Care Applied Research Network)	Federally funded since 2001; first multicenter pediatric EM research network
CHaMP	Charlotte, Houston, Milwaukee Prehospital: pediatric prehospital node of PECARN
EMSC (Emergency Medical Services for Children)	Federal program established 1984; ~40% decrease in pediatric injury deaths since its establishment

Unique Challenges in Pediatric Prehospital Research

Defining "Pediatric"
Legal minor (U.S.) = <18 years
AAP = <21 years
EMSC: base interventions on anatomy/physiology, not age alone
Pediatric Age Stratification by Organization

Organization	Age Stratification
FDA	Infancy (0–2), Childhood (2–12), Adolescence (12–21)
AAP / Bright Futures	Newborn → Infant → Toddler → Preschool → School age → Early/Middle/Late adolescence
CDC	Infants, Toddlers, Preschool, Middle childhood, Young teens, Teenagers

Sample Size
Pediatrics = ~10% of EMS volume; critical complaints = ~10–20% of that
Single agency cannot achieve adequate power alone → multicenter networks required
Consent and Assent
Parental/guardian consent required
Child's **assent** (affirmative agreement) also required when developmentally appropriate
Multiple forms may be needed targeting different cognitive levels
EFIC applicable to pediatric emergency research (same requirements as adults, but harder to obtain community support)
IRB
Children are a **vulnerable class**: additional protections required
More rigorous review and supervision

Pediatric Prehospital Research Priorities (Across Multiple Consensus Studies)

Shock/sepsis/infectious disease
Cardiac arrest
Pain management
Provider knowledge and skills
Seizures
Trauma
Respiratory distress/asthma
Resource utilization/cost

PRIORITY PATCH

Pediatrics = ~**10%** of EMS encounters; ~**2 million** prehospital pediatric encounters/year; only 10–20% have critical complaints; NOT a recognized EMS subspecialty
PECARN: federally funded since 2001; first multicenter pediatric EM research network; **CHaMP** (Charlotte, Houston, Milwaukee) = prehospital PECARN node
EMSC: federal program since 1984; ~40% decrease in pediatric injury deaths since establishment; IOM 2006 "Growing Pains" characterized pediatric EC as a multifaceted crisis
Inconsistent age cutoffs across pediatric studies prevent meta-analysis; standardized definitions (pediatric Utstein style) are a priority; children = vulnerable class requiring additional IRB protections
Child's **assent** (affirmative agreement) required in addition to guardian/parental consent when developmentally appropriate; **assent requires affirmative agreement — absence of dissent is NOT assent**; multiple consent forms targeting different cognitive levels may be needed

⚡PULSE CHECK

QUESTION 1

PECARN (Pediatric Emergency Care Applied Research Network) has been federally funded since which year?

A. 1990
B. 1995
C. 2001
D. 2006

Answer: C

PECARN has been federally funded since 2001 as the first multicenter pediatric EM research network. CHaMP (Charlotte, Houston, Milwaukee Prehospital) is the pediatric prehospital node of PECARN.

QUESTION 2

The IOM 2006 report on pediatric emergency care was titled:

A. 'EMS at the Crossroads'
B. 'Emergency Care for Children: Growing Pains'
C. 'Future of Emergency Care'
D. 'Pediatric EMS: A Critical Need'

Answer: B

The 2006 IOM report on pediatric emergency care: 'Emergency Care for Children: Growing Pains' --- characterized pediatric emergency care as a multifaceted crisis. The companion adult report was 'Emergency Medical Services at the Crossroads.'

QUESTION 3

A major sampling challenge in pediatric prehospital research is:

A. IRB approval is rarely granted for pediatric research
B. Children represent ~10% of EMS volume with critical complaints at only 10--20% of that --- single agencies cannot achieve adequate power alone
C. EFIC cannot be applied to pediatric patients
D. Parental consent is required for all pediatric research subjects

Answer: B

Children represent approximately 10% of EMS volume; critical complaints are only 10--20% of that --- single agencies cannot achieve adequate statistical power alone. This drives multicenter networks (PECARN, CHaMP). Consent challenges include parental/guardian requirement, developmentally appropriate assent, and EFIC applicability.

120 Cost Analysis Research

Key Economic Concepts

Term	Definition
Cost	Actual resources consumed to produce a good/service
Charge	Cost + taxes + profit (usually > cost; sometimes < cost)
Opportunity cost	Value of the next-best alternative foregone
Societal (community) perspective	Accounts for ALL costs regardless of who pays: recommended for all health economic evaluations

Four Types of Cost Analysis (Full Economic Evaluations)

Type	Outcome Measured In	Example
Cost-Benefit	Dollars (monetary units)	Telehealth program saves $928,000/year; $2,468 savings per ED visit averted
Cost-Effectiveness	Natural units (lives saved, life-years)	Police AED: $23,542–$70,342 per life saved; $1,582–$16,060 per year of life saved
Cost-Utility	Quality-Adjusted Life-Years (QALYs)	Lay responder defibrillation: $46,700 per QALY (95% CI $23,100–$68,600)
Cost-Minimization	Cost comparison (assumes equal outcomes)	Helicopter vs. ground for burns = 7–8× higher transportation charges for helicopter

Published thresholds: **~$50,000/QALY** and ~$200,000/good outcome are commonly cited cost-effectiveness limits.

EMSCAP Framework (EMS Cost Analysis Project)

What to INCLUDE:

Administrative overhead
Bystander response costs (CPR training programs)
Communications infrastructure
Equipment (durable + consumable)
Human resources (paid AND volunteer at prevailing wage)
Information systems
Medical oversight
Physical plant (buildings)
Training
Vehicles
Downstream costs (hospital, rehabilitation, lost wages)

What to EXCLUDE:

Taxes (revenue transfers, not true costs)
Prevention programs (outside EMS definition)
Mutual aid outside the community
Sunk costs (e.g., roads/highways)
Special events at planners' request (not anticipated need)
Revenue generation / billing costs

Joint Production Problem

When an agency serves multiple roles (e.g., fire department providing EMS), cost attribution is difficult
No consensus on best method
Common approaches: % of calls that are EMS-related; % of time on EMS calls
Can lead to over- or under-estimation of costs

Why EMS Cost Research Is Underdeveloped

2003–2013: only 60 published EMS economic evaluations; only 14 were full economic evaluations
Most of those 14 were poor quality
No standardized approach to calculating EMS costs prior to EMSCAP

PRIORITY PATCH

Societal perspective = accounts for ALL costs regardless of payer; always use **costs, not charges**; gold standard for EMS cost analysis
Four types: Cost-Benefit (dollars), Cost-Effectiveness (natural units — lives, life-years), Cost-Utility (QALYs; threshold ~$50,000/QALY), Cost-Minimization (assumes equal outcomes)
EMSCAP excludes: taxes, prevention programs, mutual aid outside community, sunk costs, special events at planners' request (**most commonly missed exclusion** — planned standby coverage is not an unanticipated EMS cost), billing costs
Joint production problem: when agency has multiple roles (e.g., fire/EMS), cost attribution is difficult; common approaches = % of EMS calls or % of time on EMS calls
Only **60** published EMS economic evaluations 2003–2013; only 14 were full evaluations; most of those 14 were poor quality; EMSCAP provided first standardized costing framework

⚡PULSE CHECK

QUESTION 1

Which type of economic evaluation measures outcomes in quality-adjusted life years (QALYs)?

A. Cost-benefit analysis
B. Cost-effectiveness analysis
C. Cost-utility analysis
D. Cost-minimization analysis

Answer: C

Cost-utility analysis measures outcomes in QALYs. Cost-benefit analysis uses dollars. Cost-effectiveness uses natural units (lives saved, life-years). Cost-minimization compares costs assuming equal outcomes. Commonly cited thresholds: ~$50,000/QALY and ~$200,000/good outcome.

QUESTION 2

The societal (community) perspective is recommended for all health economic evaluations because:

A. It is easiest to calculate using existing data
B. It accounts for ALL costs regardless of who pays them
C. It is required by CMS for Medicare reimbursement analyses
D. It excludes downstream costs that are difficult to measure

Answer: B

Societal perspective: accounts for ALL costs regardless of who pays --- the recommended approach for health economic evaluations. This includes administrative overhead, bystander response costs, downstream costs (hospital, rehabilitation, lost wages), and volunteer labor at prevailing wage.

QUESTION 3

A commonly cited cost-effectiveness threshold for EMS interventions is approximately:

A. $10,000/QALY
B. $50,000/QALY
C. $100,000/QALY
D. $500,000/QALY

Answer: B

~$50,000/QALY and ~$200,000/good outcome are commonly cited cost-effectiveness thresholds. Example: lay responder defibrillation costs approximately $46,700/QALY (95% CI $23,100--$68,600) --- within the threshold. Police AED programs: $23,542--$70,342 per life saved.

121 Statistical Concepts for Research in Emergency Medical Services

Classical Hypothesis Testing

Term	Definition
Null hypothesis (H_0)	No difference between groups
Alternative hypothesis (H_a)	A difference of defined size exists between groups
Effect size / Treatment effect	The magnitude of difference defined by H_a; must be defined *before* data collection
p-value	Probability of obtaining results as extreme as observed, *assuming H_0 is true*
α (alpha)	Preset threshold for significance (usually 0.05); risk of Type I error
β (beta)	Risk of Type II error
Power	1 − β; probability of detecting a true treatment effect; typically designed at 0.80–0.95

Type I vs. Type II Error

	Reality: No Difference	Reality: Difference Exists
Study says: Difference	**Type I Error (false positive)** = α	Correct (true positive)
Study says: No difference	Correct (true negative)	**Type II Error (false negative)** = β

Power Analysis & Sample Size

Must be calculated **before** the study (a priori), not after (post hoc power is invalid)
Four determinants of power: sample size, effect size (from H_a), data variability, α
Smaller effect sought → larger sample size required
Pilot studies must still have adequate sample size to be ethical

Data Types & Variable Scales

Scale	Description	Example
Continuous (numerical)	Values along a continuum	Age, weight, BP, response time
Discrete (numerical)	Only specific values	Number of calls per shift
Nominal (categorical)	Unordered categories	Race, sex, hospital name
Binary (dichotomous)	Two categories	Alive/dead, intubated/not
Ordinal	Ordered categories, unequal intervals	GCS score, CPC score, Apgar

Categorizing continuous variables (e.g., BP ≤90 vs. >90) loses information, may introduce bias, and reduces power.

Statistical Tests Summary

Data Type	Distribution	2 Groups	3+ Groups
Continuous	Normal (parametric)	**Student's t-test**	**One-way ANOVA**
Continuous / Ordinal	Non-normal (nonparametric)	**Wilcoxon rank-sum (Mann-Whitney U)**	**Kruskal-Wallis**
Continuous paired	Non-normal	**Wilcoxon signed-rank**	—
Categorical / Binary	—	**Chi-square**	**Chi-square**
Categorical (small n)	—	**Fisher's exact** (when any cell < 5)	—

Confidence Intervals

Point estimate = observed treatment difference in the study
Confidence interval (CI) = range within which the true treatment difference lies with X% certainty (usually 95%)

CI **excludes zero** → statistically significant (equivalent to p <0.05)
CI **includes zero** → not statistically significant; cannot rule out no difference
Width of CI reflects precision: wider = less precise = usually smaller sample size

Multiple Comparisons

Bonferroni Correction: divide desired α by number of tests performed; reduces Type I error risk but increases Type II error risk
Gatekeeping: pre-specified sequential testing order; only test next hypothesis if previous was significant

Multivariable Analysis

Used when multiple variables may influence an outcome (e.g., confounders)
Multivariable logistic regression: most common in EMS research
Binary/dichotomous outcome (e.g., survival)
Produces **odds ratio (OR)** with CI for each predictor
Controls for confounders simultaneously

Clustering

Subjects sharing common features (same EMS agency, same crew) tend to have correlated outcomes
Violates assumption of statistical independence
Failing to account for clustering → falsely narrow CIs and artificially low p-values (increased Type I error)
Must use cluster-appropriate analytic methods (e.g., mixed-effects models, GEEs)

Intention-to-Treat (ITT) Analysis

Patients analyzed in the group to which they were **originally randomized**, regardless of whether they actually received the assigned treatment
Preserves the benefit of randomization
Reflects effectiveness in real-world practice (including implementation failures)

Subgroup Analysis

Proper subgroup: defined by characteristics present at initial EMS contact, NOT modified by the intervention
Improper subgroup: defined by post-intervention characteristics (e.g., BP after fluid administration)
Problems: multiple comparisons increase Type I error; smaller groups reduce power
Must be pre-specified and integrated into original sample size calculation

Missing Data

Strategies: complete case analysis, exclusion of missing cases from model, **multiple imputation**
Key assumption for valid methods: missingness is "ignorable" (missing at random or missing completely at random)
Plan for handling missing data must be specified **before** the study begins

PRIORITY PATCH

Type I (α) = false positive (finding difference that doesn't exist); **Type II (β) = false negative** (missing a real difference); **Power = 1−β**; most common cause of Type II error = inadequate sample size
Fisher's exact: use when any cell in 2×2 table has <5 expected observations; **Bonferroni**: divide α by number of tests (reduces Type I, increases Type II)
Statistical significance ≠ clinical significance: CI excluding zero with huge n = significant but may be trivial; wide CI in "negative" trial may still include clinically important differences
Clustering: correlated data from same agency/crew violates independence assumption; failing to account → falsely narrow CIs and artificially low p-values (increased Type I error); **solutions: mixed-effects models or GEEs** (generalized estimating equations) — must be specified in the methods
Post-hoc power analysis is **invalid**; interpret negative studies with 95% CI instead; ITT = analyze all patients in originally randomized group regardless of actual treatment received
Subgroup analyses must be pre-specified; post-hoc subgroup findings are **hypothesis-generating only** — a striking p-value from a post-hoc subgroup cannot confirm an effect regardless of magnitude

⚡PULSE CHECK

QUESTION 1

In classical hypothesis testing, a p-value of 0.03 (with alpha set at 0.05) means:

A. There is a 3% probability the null hypothesis is true
B. There is a 3% probability of obtaining results as extreme as observed, assuming the null hypothesis is true
C. The treatment effect size is 3%
D. There is a 97% probability the treatment works

Answer: B

The p-value is the probability of obtaining results as extreme as observed ASSUMING the null hypothesis is true. It does NOT directly state the probability that H0 is true. Alpha (0.05) is the pre-set threshold for significance --- the risk of a Type I error (false positive).

QUESTION 2

Type II error in research is:

A. Concluding there is a difference when none exists (false positive)
B. Concluding there is no difference when one actually exists (false negative)
C. Using the wrong statistical test for the data type
D. A sample size too large to detect a meaningful difference

Answer: B

Type II error (beta) = false negative --- concluding no difference when one actually exists. Type I error (alpha) = false positive. Power = 1 − beta = probability of detecting a true treatment effect. Studies are typically designed with 80--95% power.

QUESTION 3

Power analysis must be performed at which point in the research process?

A. After data collection, to confirm adequacy
B. Before the study begins (a priori)
C. During data collection if sample targets are not being met
D. After study completion to determine if the result was meaningful

Answer: B

Power analysis MUST be calculated before the study (a priori), not after (post hoc power is invalid --- it simply restates the observed p-value in different terms). Four determinants of power: sample size, effect size, data variability, and alpha. Smaller effect sought = larger sample needed.

FINAL REVIEW

Last Minute Cram

High-yield facts, dates, and pearls for the final 24 hours before your exam

NUMBERS TO KNOW COLD

EXPLANATION	KEY / FACT
ABEM recognized EMS as 6th EM subspecialty (IOM 2006 report was the catalyst)	**September 2010**
"Accidental Death and Disability" (NAS) — seminal EMS document; also year of Highway Safety Act creating DOT/NHTSA	**1966**
EMS Systems Act — first comprehensive federal approach; 15 required components	**1973**
Omnibus Budget Reconciliation Act — ended direct federal EMS funding	**1981**
First hospital-based helicopter program: St. Anthony's Hospital, Denver, CO	**1972**
CMS Balanced Budget Act — drove rapid air medical growth via reimbursement increase	**1997**
Emergency declaration: can be made *before* disaster strikes to pre-position resources; does NOT require documented impact. **Major disaster declaration**: requires documented impact; comprehensive federal support. Knowing the pre-disaster capability of the emergency declaration is directly tested.	**Stafford Act: 2 types**
PPAEMA signed — standing orders for controlled substances now legal; ambulance service (not medical director) is DEA license holder	**2017**
Partial overtime exemption for public safety EMS — allows a longer work period (up to 28 days) before overtime calculations kick in; tested in EMS finance and staffing questions	**FLSA §7(k)**
Paramedic candidates must graduate from CAAHEP-accredited program to sit for NREMT	**2013**
9/11 → NRP (2004); Katrina → NRF (2008, addressed NRP bureaucracy); Sandy → "whole community" concept (2013 2nd Ed); 4th edition (2019) is current	**NRF evolution (lesson-driven)**
ET3 (CMS pilot) **launched 2019**; payments began **2021** — distinguish launch year from operational start; EMS Agenda 2050 published 2019; National EMS Scope of Practice Model revised 2019	**2019 / 2021**
Median sensitivity of EMD for cardiac arrest recognition at dispatch	**73.9%**
Dispatcher stroke tool: sensitivity / specificity	**86.4% / 26.6%**
Average time saved using L&S (Hunt, 1995); only 6.9% of calls involve life-saving interventions	**43.5 seconds**
EMS vs. general public fatality rate; 76–86% of EMS fatalities are transportation-related	**6.3 / 4.0 per 100K FTE**
Ambulance crashes as % of all EMS tort claims; >50% of fatal crashes cross intersections; rear = 3× more fatal than front (**largely exempt from federal vehicle safety standards** — regulatory explanation for disparity)	**37%**
Impairment equivalent after 21 hours of wakefulness; legal commercial driver limit is 0.04%	**0.08% BAC**
Employer liability for fatigue-related crashes may extend **after the shift ends** (post-shift commute crashes) — shared responsibility does not end at clock-out	**OR/WV precedents**
Blocks thyroid uptake after radioactive iodine exposure — **only effective before or immediately after exposure**; iodine is the most clinically important internal radiation exposure because of the thyroid concentration mechanism; give KI, not just decon	**KI (potassium iodide)**
EMS clinicians with poor sleep quality; 36% have excessive daytime sleepiness (ESS ≥10)	**60–72%**
EMS clinicians overweight or obese (vs. ~40% general population)	**71–80%**
EMS clinicians assaulted on the job; ~32% of injuries go unreported	**>60%**
Threshold for PTSD behavioral health referral (out of 10 items)	**TSQ ≥6**
Risk reduction from vaccination; anti-HBV titer ≥10 mIU/mL = protected; HBIG for non-responders = ~71%	**HBV 98%**
Start within 72 hours; run 4 weeks; preferred = raltegravir + tenofovir/emtricitabine; **discontinue if source patient tests HIV-negative**	**HIV PEP: <72h**
Caffeine limit during emergency ops; energy drinks NOT recommended; fixed vital sign cutoffs abandoned in 2021	**NFPA 1584: 400 mg/day**
Medical surveillance records retained 30 years post-termination; employee access within 15 days	**Records: 30 years**
Requires CMS application weeks in advance — most commonly overlooked pre-deployment step for temporary treatment facilities; impossible to obtain quickly during an active emergency; apply before need arises	**CLIA waiver: weeks**
Arrest not witnessed by EMS + no shockable rhythm + no ROSC before transport = **99.5% PPV for death**, 90% specificity for survivors; validated wilderness/prolonged transport TOR decision tool	**Verbeek BLS TOR Rule**
24-hr window applies only to patients meeting DAWN/DEFUSE-3 criteria: **large penumbra + small infarct core** on imaging — not all LVO strokes qualify; overgeneralizing to all LVO = high-yield exam error	**Thrombectomy: selected only**
§1983 Civil Rights Act requires a "state actor"; private EMS may escape unless operating under **color of state law** (exclusive franchise, government contract); when §1983 applies: state immunity bypassed, damage caps voided, punitive damages + attorney fees available, standard malpractice policies do NOT cover	**§1983: state actor required**
State compact, NOT federal licensure; states may still restrict above compact floor; 20 states enrolled as of 2020; does not create uniform national practice rights	**REPLICA: state compact**
Altitude **compounds** CO toxicity even after O_2 therapy; prefer ground transport for significant CO exposure when feasible; CN toxicity resolves quickly (arrest or seize = treat pre-transport, not en route)	**CO + altitude**

Basic skills decay within 2 years: EMTs / paramedics (Latman & Wooley)	**50% / 61%**
Current national EMS quality standard (2018); took over from EMS Compass (14 measures, 2016) which evolved from NHTSA 2009 (35 measures); progression 35→14→11 reflects increasing consensus	**NEMSQA: 11 measures**
>205 systems, >350,000 transports; DASH-1A = definitive airway without hypoxia/hypotension on first attempt	**GAMUT: 27 measures**
Air medical share of all U.S. ambulance transports; 54% interhospital, 33% scene, 13% other	**~2% of transports**
Typical mass gathering patient presentation rate	**PPR: 0.5–2 per 1,000**
Self-sufficient / typical deployment duration; 5,000 personnel in ~80 teams; deploy within 8 hours	**NDMS: 72h / 14 days**
Only MUCC-compliant triage system; START = most widely used but NOT MUCC-compliant	**SALT ≥ MUCC**
U.S. survival to discharge (range 7.8–15% by state); international ~9.7% (range 3.1–22%); Utstein accounts for ~50% of outcome variation between registries	**OHCA survival 10.4%**
Standard OHCA trial neurological outcome threshold; CPC 3–4 = unfavorable; CPC 1 = good (can work); CPC 2 = moderate disability (independent ADLs); mRS increasingly used as alternative	**CPC 1–2 = favorable**
Cannot calculate in field/ED; RTS (GCS + BP + RR) = field score; TRISS = RTS + ISS + age	**ISS: hospital only**
Always use costs not charges; exclude taxes, sunk costs, billing, prevention, mutual aid outside community	**EMSCAP: societal**
Common cost-utility threshold; cost-utility = QALYs; cost-effectiveness = natural units (lives saved)	**$50,000/QALY**
Most common cause = inadequate sample size; Power = 1−β; Fisher's exact when any cell <5 expected	**Type II error: sample size**
Six Sigma defect rate; PDSA = start small; common cause vs. special cause variation = central QI distinction	**3.4 per million**

MNEMONICS THAT EARN THEIR KEEP

MNEMONIC	EXPANSION
FLOP	ICS Sections: Finance, Logistics, Operations, Planning
MARCH	Warm zone (TEMS): Massive bleeding → Airway → Respiratory → Circulation → Hypothermia (+2nd H = Head injury in some programs)
XABC	TEMS equipment: e**X**sanguination, **A**irway, **B**reathing, **C**irculation — no code drugs (CONTOMS data)
ID-MED	SALT/MUCC categories: **I**mmediate · **D**elayed · **M**inimal · **E**xpectant · **D**ead
SALT 3 Steps	(1) Global Sort: walk/wave/still → (2) LSIs if within scope + equipment available → (3) Assign category (ID-MED)
STEEEP+P	IOM 2001 six aims: Safe · Timely · Effective · Efficient · Equitable · Patient-centered (the +P is the sixth aim)
PDSA	Plan-Do-Study-Act; start small — most QI failures = system-wide rollout without small-scale testing
DMAIC	Six Sigma: Define · Measure · Analyze · Improve · Control
OREO	Political action: Opportunities · Resources · Expectations · Obstructions
4 Es	Injury prevention: Education · Engineering · Economics · Enforcement
PPD-8 (5 areas)	Prevention · Protection · Mitigation · Response · Recovery
Case-Control / Cohort	Case-Control = Consequence (outcome) → look back; Cohort = Cause (exposure) → follow forward
NFPA numbers	1581 = infection control · 1582 = occupational medical · 1583 = health/fitness · 1584 = rehab
Kirkpatrick 1-2-3-4	Reaction (smile sheet) → Learning (test) → Behavior (field obs.) → Results (outcomes); Level 4 needs sustained effort
PICO	Patient · Intervention · Comparison · Outcome; every question must pass the “So what?” test
Fix Var Step Mar Dep Opp Sunk	EMS cost types: Fixed · Variable · Step · Marginal · Depreciation · Opportunity · Sunk

RESEARCH, STATISTICS, AND COST: FINAL CHECKLIST

CONCEPT	KEY POINTS
EFIC (21 CFR 50.24)	FDA; higher-risk emergency research; requires IND or IDE; first used in DCLHb trial; last resort — condition 9 (cannot practicably proceed without waiver) reinforces this
WIC (45 CFR 46.116)	HHS/IRB; lower-risk research; FDA is *not* a Common Rule agency
Community consultation vs. public disclosure	Consultation = bidirectional (town halls, opt-out mechanism); disclosure = one-way broadcast before and after study
Belmont Report	Respect for Persons + Beneficence + Justice (fair distribution of *both* risks AND benefits); foundation for Common Rule (1991)
Ethics timeline	1964 Helsinki → 1974 National Research Act (post-Tuskegee) → 1979 Belmont → 1991 Common Rule → 1993 FDA halts resuscitation research → 1996 EFIC created
DSMB stopping rules	(1) Benefit; (2) Harm; (3) *Futility* — enrollment unlikely to change outcome. Futility ≠ harm; it is the most commonly missed criterion
Subgroup analyses	Must be pre-specified; post-hoc = hypothesis-generating only regardless of p-value; defined by post-intervention characteristics = always invalid
ITT analysis	All patients analyzed in originally randomized group regardless of treatment received; preserves randomization benefit
Clustering	Same agency/crew = correlated outcomes; ignoring → falsely narrow CIs and low p-values; solutions: mixed-effects models or GEEs
Bonferroni / Fisher's exact	Bonferroni: divide α by number of tests (↓ Type I, ↑ Type II); Fisher's exact: any 2×2 cell <5 expected observations
Donabedian / STEEEP+P	Structure + Process + Outcomes; IOM 2001 six aims = Safe, Timely, Effective, Efficient, Equitable, Patient-centered
Common vs. special cause variation	Common = inherent in system → change the system; Special = external specific cause → find and fix that cause
NEMSIS 2019	37M activations; 10,062 agencies; trauma = 13.4%; 65% treated/transported — *35% are not* (data foundation for MIH/CP and 9-1-1 triage)
Utstein Style	Standardized OHCA reporting (1991, updated 2015); ~50% of outcome variation; EMS-assessed (broader) vs. EMS-treated (narrower) denominators
ILCOR COSCA outcomes	Survival to discharge + modified Rankin + HRQoL (SF-36, EQ5D-5L) at 90 days and up to 1 year
Reporting standards	CONSORT (RCTs) · STROBE (observational) · PRISMA (systematic reviews) · MOOSE (observational meta-analyses)
JTTR findings	Widespread tourniquet adoption; Factor VIIa restricted after thromboembolic events found during long transport
PECARN / pediatric research	Federally funded since 2001; CHaMP = prehospital node; assent = affirmative agreement (not absence of dissent) required alongside guardian consent
GCS <5 exclusion	Methodological, not purely ethical — unsurvivable injury dilutes treatment effect even if intervention is effective

THE HARDEST WRONG ANSWERS ON THIS EXAM

- **EMTs do NOT practice "under the physician's license."** They practice under their own state license, under physician supervision. Supervision ≠ agency (employer relationship).
- **NREMT certification does NOT grant the right to practice.** State licensure does. Certification = competency verification. They are not interchangeable — but if a state calls it "certification" while granting practice rights, it functions legally as a license.
- **§1983 (Civil Rights Act) bypasses state immunity entirely.** State damage caps do not apply. Most malpractice policies do NOT cover §1983 claims or administrative liability.
- **The highest-risk EMS liability area is NOT airway management.** It's nontransports and patient refusals. Informed refusal requires decisional capacity + disclosure of diagnosis, treatment, alternatives, and consequences.
- **"A&O ×3" does NOT establish decision-making capacity.** EMS cannot diagnose but does evaluate capacity. This is one of the most commonly tested distinctions in the legal chapters.
- **At-will employment has NO property interest.** Fixed-term contract, tenure, or implied promise = property interest. Due process applies only to government action — private conduct is not covered no matter how unfair.
- **HIPAA is NOT a barrier to sharing outcome data with EMS for QI.** This is a myth explicitly addressed in the textbook. HIEs should enable bidirectional data flow.
- **CISM/CISD is NOT evidence-based for PTSD prevention.** Multiple authoritative guidelines caution against or contraindicate routine debriefing. Current standard = Stepped Care framework (NFPA 1500, 2013).
- **The #1 reason cardiac arrest is missed at dispatch is agonal breathing** — "making funny noises" is cardiac arrest until proven otherwise, not normal breathing.
- **L&S saves only 43.5 seconds on average.** Only 6.9% of calls involve potentially life-saving interventions. Risks are disproportionate to benefit for most calls.
- **Rear ambulance compartment is NOT the safe area in a crash.** It is ~3× more likely to have a serious/fatal injury than the front, and is exempt from federal vehicle safety standards.
- **SALT is the only MUCC-compliant triage system.** START is most widely used but is NOT MUCC-compliant. Push your agency toward SALT.
- **Crisis standards of care require a formal declaration** from governor or HHS secretary — NOT blanket permission to disregard laws.
- **Failure to provide prearrival CPR instructions is now viewed as potentially negligent.** DA-CPR is a medical *standard of care* for telecommunicators — not optional guidance. A telecommunicator who fails to provide CPR instructions when indicated may expose the agency to liability.
- **Radioactive contamination is NOT an immediate threat to providers** as long as material stays outside the body. Treat first, decontaminate after. Ingestion is the greatest hazard.
- **Financial sustainability is the #1 MIH/CP failure point.** Grant-funded programs consistently collapse when funding ends. The mechanism: **generated savings ≠ captured savings** — reduced ED visits that save insurer money don't flow back to the EMS agency; without capturing the savings, the program cannot sustain itself. It is not a clinical or regulatory failure — it's a financial design flaw.
- **Reckless behavior → punitive action.** Human error → console; at-risk behavior → coach. These are not interchangeable.
- **PDSA must start small.** Most QI failures occur from system-wide implementation without small-scale testing. Starting system-wide is not ambitious — it's how QI projects die.

- **Digital radio systems drop calls suddenly — analog systems fade gradually.** In rural or marginal coverage areas, a crew on digital radio may lose contact with medical direction without any warning. This is not a minor technical detail: it has direct patient safety implications and must be addressed in communications planning with redundancy (e.g., cellular backup, satellite).
- **Post-hoc subgroup analyses are hypothesis-generating only.** Even a $p < 0.001$ from a post-hoc subgroup cannot confirm an effect — the multiple comparisons problem means the finding is likely spurious. Pre-specification is the only protection. Subgroups defined by post-intervention characteristics (e.g., BP after treatment) are always invalid regardless of when the analysis was done.
- **Post-hoc power analysis is invalid.** Use the 95% CI to interpret a negative trial instead.
- **Statistical significance ≠ clinical significance.** A huge sample can make a trivial effect statistically significant. Always interpret with CI and effect size.
- **ISS cannot be calculated in the field or ED.** It requires full anatomical injury survey. RTS (GCS + BP + RR) is the field-computable score.
- **Cost analysis: always use costs, not charges.** Charges include taxes and profit and do not represent resource consumption. Societal perspective = gold standard.
- **Operational control of air medical transport always defers to the FAA Part 135 certificate holder** — not the medical director, not the mission. Safety wins.
- **In due process proceedings, notice must state ALL grounds at the outset.** Additional incidents cannot be introduced at the hearing. A medical director who adds new charges at the hearing — even legitimate ones — may invalidate the entire proceeding. This is a procedural trap that has overturned real EMS disciplinary cases.
- **Safety Officer can override the IC for imminent life safety threats only** — not general tactical disagreements. The override power is narrow. A Safety Officer who uses it for strategic disagreements is out of role.
- **Unified Command does NOT merge agency authority.** Agencies maintain separate command responsibilities while sharing the command function. Responders still report to one supervisor within their own chain.
- **Mass gathering staffing ratios are NOT evidence-based.** The Saunders response interval model (BLS ≤4 min, ALS ≤8 min, transport ≤30 min) is the evidence-informed standard. Using ratios alone is not justified by the literature.
- **Assent requires affirmative agreement.** A child who does not say "no" has NOT given assent. Absence of dissent and assent are not the same thing. This distinction matters in pediatric research — IRBs and sponsors may accept absence of resistance; the standard requires the child to affirmatively indicate willingness to participate.
- **Belmont Justice = fair distribution of BOTH risks AND benefits.** Defining Justice as only about fair distribution of risk is a common exam error. Benefits must also be distributed fairly — research populations should not bear all the burdens while different populations receive all the benefits.
- **Immediate care before decon applies to immediately life-threatening conditions only.** Airway obstruction, exsanguination, and nerve agent antidotes qualify. Non-life-threatening care — even painful or distressing — waits until after decontamination to prevent secondary contamination of responders. Misapplying the "treat first" principle broadly puts responders at serious risk.
- **TEMS physician never enters the barricaded area.** Assessment occurs through the negotiator only. Entering violates the tactical role boundary regardless of perceived clinical urgency — a physician in the hot zone without tactical training is a liability, not an asset. Never agree to demands, make promises, or cross the perimeter for any clinical reason.
- **Due process is flexible, not absolute.** "What process is due" depends on (1) private interest at stake, (2) risk of erroneous deprivation, (3) government's interest. Not all elements required in every situation.

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